SCIENTIFIC AMERICAN

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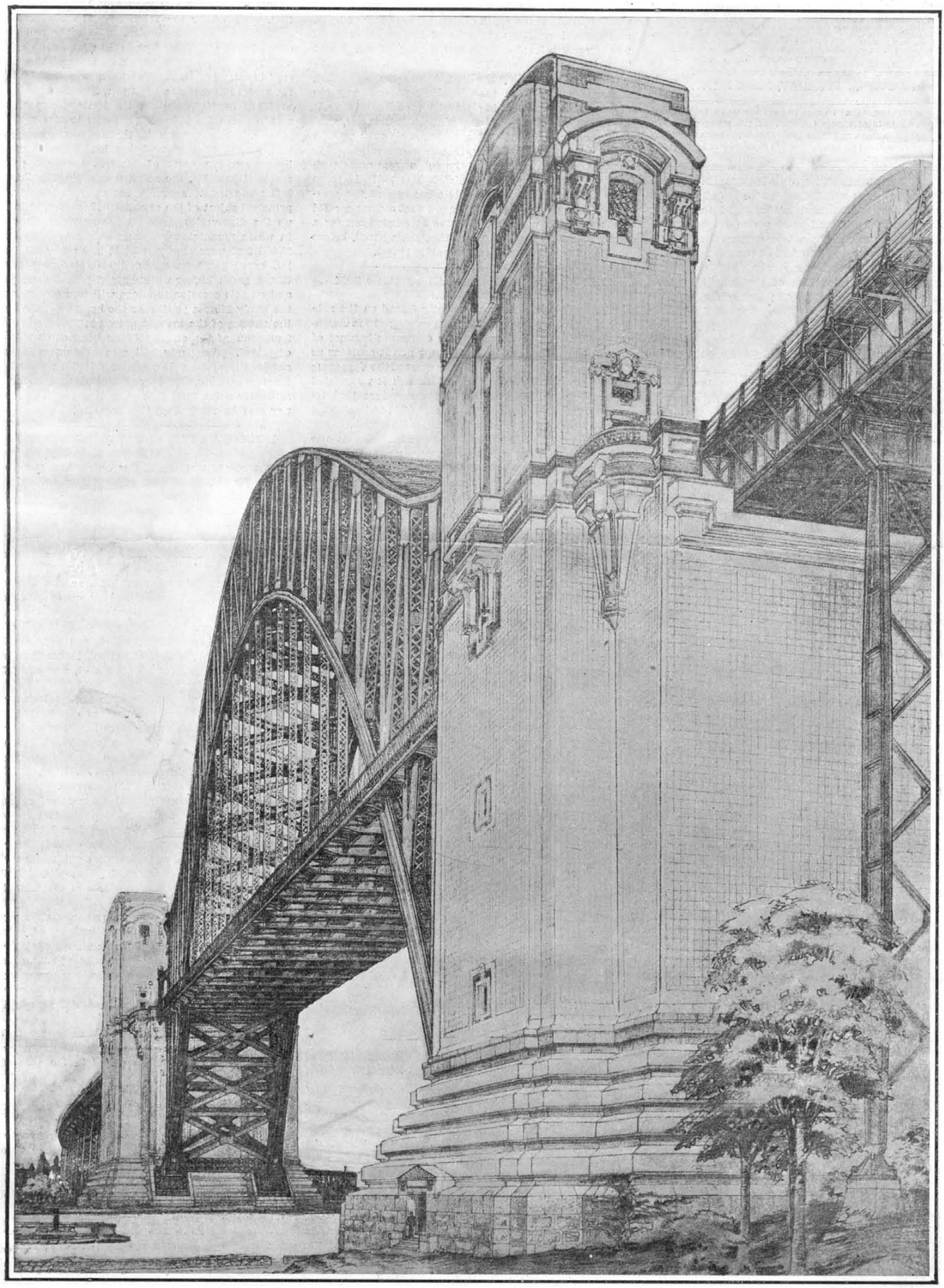
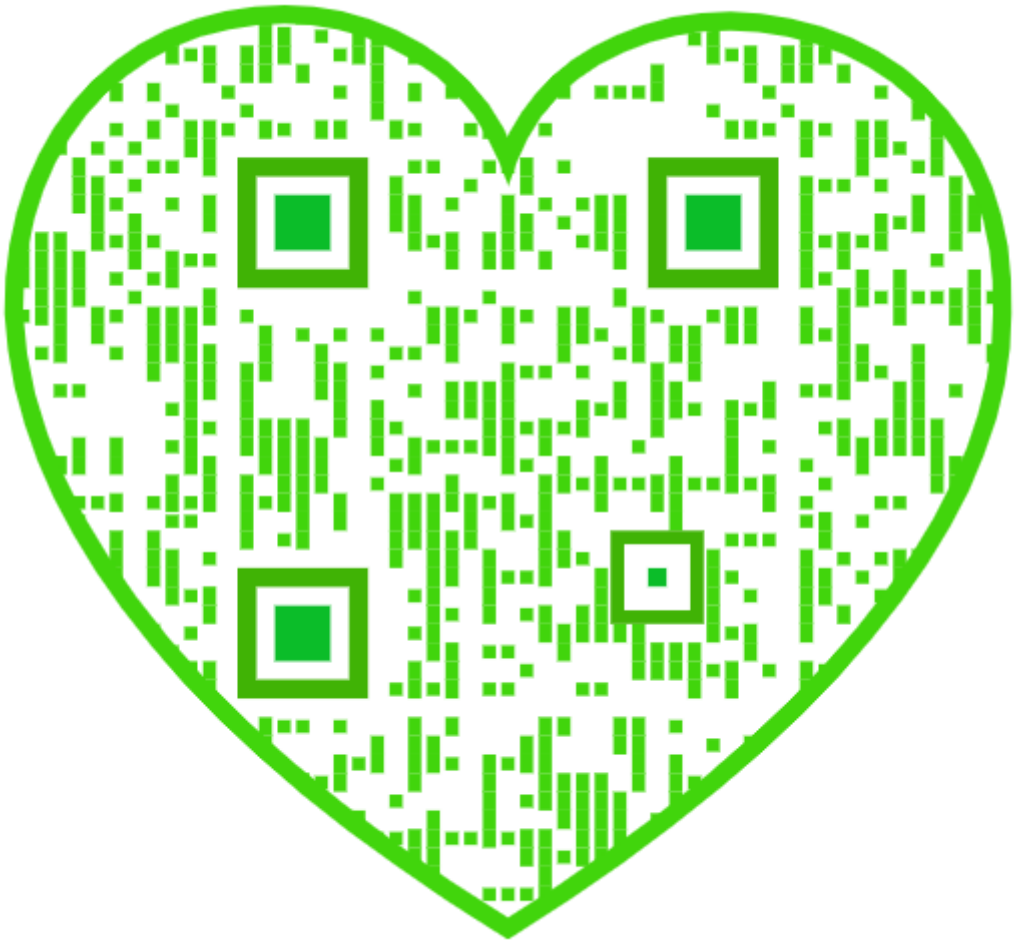
Vol. XCVI.—No. 23. ESTABLISHED 1845. NEW YORK, JUNE 8, 1907. 10 CENTS A COPY $3.00 A YEAR.



THE ONE-THOUSAND-FOOT FOUR-TRACK ARCH BRIDGE OF THE CONNECTING RAILWAY WHICH WILL SPAN THE EAST RIVER, NEW YORK.—[See page 468.]



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ESTABLISHED 1845

MUNN & CO. - - Editors and Proprietors

Published Weekly at
No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year, for the United States or Mexico.....$3.00
One copy, one year, for Canada..... 3.75
One copy, one year, to any foreign country, postage prepaid, £0 18s. 6d. 4.50

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Scientific American (Established 1845).....$3.00 a year
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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, JUNE 8, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

TUNNEL TUBES IN SOFT MATERIAL.

It has now developed that the engineers of the East River Rapid Transit tunnel are engaged in sinking piles through the silt and sand which lie below the tunnel, in order to provide a firm support for the two tubes throughout some 2,000 feet of their length. The chief engineer of the company which holds the subcontract for the construction of the tunnel believes that these piles are necessary to insure the stability and permanence of the two tubes. The chief engineer of the Rapid Transit Commission considers that the piles are unnecessary, but is willing to have them put in, saying that they can do no harm and will increase public confidence in the tunnel.

We doubt if we could find among the larger and more serious engineering works, one in which there is more divergence of opinion among engineers than that of tunnel construction by the method of driving tubes through the soft material of river bottoms. When the question of tunneling the East and North rivers came up for consideration, the problem was in some respects a new one; for although the Greathead shield system had been employed many years before in building a tunnel beneath the Thames, the material under that river differed so widely from this below the two rivers of New York, where the bottom consists largely of a semi-fluid silt, that the New York problem had to be treated quite independently and subject to its own special conditions.

When a cast-iron tunnel is driven through the sand and gravel or the stiff clay of London, there is no question of its subsequent stability—where it is placed it will remain for all time. But when the suggestion was made to drive from 2,000 to 4,000 feet of cast-iron tube through the comparatively soft and semi-fluid mud at the bottom of our rivers, the question of permanence became all-important and called for careful consideration. So serious did it appear to Mr. Jacobs, chief engineer of the various tunnels under the North River, that he decided to sink massive piling clear across the river, build a track structure from pile to pile of sufficient strength to carry unaided the load of the moving traffic, and treat his tubes as a mere envelope, whose duty it was, not to support the load, but merely to provide an air-tight tube through which the trains might run. He carried this idea of separating the weight-carrying and the enveloping elements in his tunnel so far, that he provided sliding joints in the bottom plates of the tube where the piles passed through, the idea being that any slight movement of the tubes might take place independently of the piles and track structure.

The success of the work under the Hudson and East rivers proves that it is entirely possible to build as many tunnel tubes as may be desired. But the question which has yet to be proved, and which is exercising the minds of some of the ablest engineers in this city to-day, is, how far will the vibration set up in the metal tubes by the passage of the trains tend to agitate the surrounding material sufficiently to cause its displacement and a consequent settlement of the tubes? If such a settlement did occur to any great extent in a rigidly bolted-up member, less than 20 feet in diameter and from 2,000 to 3,000 feet in length, and rigidly supported at the ends, there would be bending stresses developed which would be far in excess of the resisting power of the tubes, and fracture must ensue. But whatever theory may indicate. time alone can tell whether the vibrations of the trains will have any disturbing effect upon the surrounding mud and silt. Personally, we are of the decided opinion that it will, and that in all portions of the various tunnels now under construction which lie in material of less than a certain density and compactness, the piles should be sunk through the bottom of the tubes until they reach rock or some other sufficiently firm bearing. Moreover, with all due deference to Mr. Jacobs's theories, we believe that the piles should be anchored securely at their upper ends to the shell of the tunnel.

In the case of the East River Rapid Transit tunnels, the piling is being driven by the jet process at intervals of 50 feet over a stretch of about 2,000 feet, where the tunnel passes through soft mud. But if the piles are to be used, they should be driven closer together; for the reason that the wide spacing will tend to set up undesirable bending stresses between the rigid points of support. Twenty-foot, or at the outside 25-foot, intervals would have been better.

The experience had with the Brooklyn tunnel proves that in future subaqueous tunnel construction it would be advisable, where the route lies through soft silt and mud, to increase the depth of flanges, diameter of bolts, and general resisting strength of the cast-iron shell. The frequent breakages in the lining of the Rapid Transit tubes, both during construction and since construction was completed, afford, to say the very least, a strong presumption that the lining is not any too strong for its work. It is claimed by the Rapid Transit engineers that these fractures of the plates were caused by wrong methods of construction. This may well be true; but what about any fractures of plates which may have taken place since the tubes were completed, and the last of the lining plates inserted? If there have been such fractures, public safety and the prestige of everyone concerned demand that a most careful system of tests with loaded trains be carried out for a reasonable length of time, and the effects noted, before the tubes are thrown open for public travel.

THE PROBLEM OF RAISING AN EXISTING DAM STRUCTURE.

The parliamentary paper recently issued on the subject of irrigation in Egypt and the raising of the Assouan dam, will be disappointing to engineers because of the meager amount of information which it contains as to just how the feat of lifting the crest of the dam some 22 feet is to be accomplished. Although it was stated at the time of the opening of the structure that its proportions were such as would permit it to be carried up 20 feet higher without impairing its stability, the illustrations of the finished work indicated that the width and thickness of the dam were not sufficient to enable the structure to withstand the increased stresses which would be due to such a great increase in the head of water.

In a memorandum in the parliamentary paper above referred to, Sir Benjamin Baker gives some interesting information on the subject, although he fails to make clear in what way the enlargement of the dam is to be carried out. He states that two years ago plans were submitted to him for the increase of the dam, and that, after careful consideration, he stated that further experience was necessary as to the practical working of the existing structure, and further investigation of the mathematical problems involved, before a satisfactory design could be prepared. This statement alone would indicate that the existing portion of the dam was built to withstand only its present head of water, and that the proposal to raise that head by 22 feet involves the construction of what is practically a new dam, built around the present structure as a nucleus.

Sir Benjamin Baker states that the masonry aprons constructed on the downstream side during the past two years will effectually protect the bed of the river against erosion, even when the scouring action of the water rushing through the sluices is increased by the raising of the water in the reservoir. Furthermore, he gives it as his opinion that the existing dam and locks may be easily modified so as to admit of the level of the water being raised 22 feet, without introducing any element of danger whatever or impairing the present factor of safety. During the past two years the engineering staff at the dam have obtained valuable data relating to the varying temperature of the mass of masonry constituting the dam, data which have an important bearing upon the stresses on the masonry, and upon the details of any design for raising the dam. These temperature variations have rendered the designing of the new work a difficult problem, since any new masonry bonded to the existing masonry would have been of a different temperature and of doubtful utility in adding to the stability of the dam.

Judging from the above, it would seem that the enlargement of the dam is not to be carried out by thickening its whole mass, and building up the additional height in new masonry bonded into the existing structure; though we fail to see, since the building of the new work is to take six years' time, how the gradual enlargement of the dam, and the addition of block by block as the work proceeds, should present such differences in temperature between the old and the new as to involve undesirable temperature stresses, and prevent the whole completed dam from acting as a true monolithic mass. It is possible, however, that the plan contemplates the use of some form of movable steel dam structure of the kind that is used so widely in this country for regulating the height of water in dams and rivers; though even in this case the proper support of such a structure would require a widening of the base of the dam proportionate to the increased head, and the provision of massive abutments between the existing sluiceways to take the horizontal thrust of the additional water.

THE SHACKLETON ANTARCTIC EXPEDITION.

A new British Antarctic expedition, organized by Mr. E. H. Shackleton, who was third lieutenant on the "Discovery," and who formed one of the party which penetrated "farthest south," is to leave London in October next. On this exploration full avail is to be made of the experience gained in the former expedition, with a view to avoiding being frozen in, and to facilitate travel over the ice. The party will proceed directly to New Zealand, and will then sail to the point which constituted the winter quarters of the "Discovery" in lat. 77.50 S. A shore party will here be landed, the vessel returning to Lyttleton, New Zealand, thereby avoiding imprisonment in the ice, and the ship will return south the following summer to pick up the explorers. It is hoped that the financial arrangements will permit of a party being landed at Mount Melbourne on the coast of Victoria Land, in order to reach, if possible, the south magnetic pole, this route being the most favorable for such a journey. The principal object of the expedition, however, is to follow up the discoveries made on the previous exploration, in which mountains ranging in altitude from 3,000 to 15,000 feet were discovered. It is stated that had the last expedition been equipped with better sledge facilities, a much higher altitude might have been gained; and on this occasion the dogs will be supplemented by the hardy Siberia ponies for the haulage of the sledges, the surface of the ice and snow together with the configuration of the country being adapted to this mode of travel. The party will also be equipped with an automobile of special design to suit the unusual conditions prevailing. It is anticipated that a far more southerly point than that gained on the previous journey may be reached on this occasion.

INFLUENCE OF LIGHT ON THE CONDUCTIVITY OF ANTIMONITE.

At a recent meeting of the Dutch Academy of Sciences, Mr. F. M. Jaeger reported on some interesting experiments illustrating the peculiar behavior of the conductivity of Japanese antimonite in regard to light.

After accidentally discovering that a beam of light falling on a rod of this substance inserted in an electric circuit would produce a deflection of the galvanometer needle, corresponding with an increase in conductivity, Jaeger investigated the cause of this phenomenon, obviously due either to light or to heat.

The first experiments were made on a rod of antimonite coated with wax, which rod accordingly exerted only a relatively small effect, increasing the conductivity by 10, 20, or 200 per cent, according to the conditions of the case.

Far more intense effects were observed on an antimonite plate inserted between two insulated copper plates of considerably greater dimensions. The condenser thus constituted was suspended by a silk thread. As heat was found to diminish the conductivity instead of increasing it like light, only light could be the cause of the phenomenon.

On inserting glass plates of different colors between the source of light and the antimonite rod, the effects of differently colored lights were found to be rather different. A minimum of luminous sensitiveness was found to correspond with the ultra-red, another degree to the green, and a third to the ultra-violet, while the red and blue regions of the spectrum constituted maxima of sensitiveness.

The above phenomenon shows a striking resemblance to the luminous sensitiveness of selenium. Though the relation between luminous radiation and increase in conductivity, generally speaking, is analogous in both cases, there are a few remarkable departures. In the first place, polymorphous conversions and the resulting displacements in equilibrium are known to play an important part in the case of selenium. On the other hand, its resistance is known to decrease continually with increasing temperature, in opposition to the facts stated in the case of antimonite.

Tellurium seems to show a behavior analogous to antimonite, its resistance being likewise increased by heating and reduced by illumination.

It is intended shortly to construct antimonite cells sensitive to light on a principle analogous to that underlying the construction of selenium cells.

It is said to be extremely important to the proper setting of concrete, if the best results are to be obtained, that it be protected while the process is going on from the wind and sun, especially in dry, warm weather. The dry air will rob the sharp corners, and even the faces, of their moisture, and a later wetting will not repair the damage.

GOVERNMENT TESTS OF SAFETY DEVICES FOR MINES.

Determined endeavors to stop the appalling sacrifice of human lives in the coal mines of the United States are to be made at once by the fuel division of the Geological Survey, thus supplementing its efforts to lessen the waste of fuel in mining operations.

Plans have been drawn for a unique experimental station at which tests of the various dynamites and powders used in blasting coal will be made with a view to determining accurately their safety in the presence of the deadly fire-damp and perhaps equally deadly coal gas. Explosives of all sorts will be hurled by means of a mortar into a mammoth boiler-plate cylinder which has previously been filled with gas, and the effects will be carefully noted. If ignition fails after severe test the explosives will be known as "permissible explosives" and their use will be urged upon the mine owners of the country.

In addition there will be important experiments in rescue work. One part of a station will be fitted up as a miniature coal mine, and miners and operators will be taught the noble art of saving the lives of fellow men. It is declared that in serious gas explosions in mines, hundreds of lives could be saved were it possible for the rescue party to enter immediately after the accidents. As it is now, the deadly fire-damp often holds the men back for hours while their comrades are slowly being suffocated or burned to death.

In their investigations so far, the government experts have found an apparatus in Europe, which when worn by the members of a rescue party, enables them to enter any place where there is gas. At the experimental station, the miniature mine will be filled with dense smoke and practical demonstrations in the saving of life with this apparatus will be made.

A definite location for the experimental station has not yet been selected, but it is probable that the station will be in the Pittsburg district.

"We intend to begin the erection of this station within a few weeks," said Dr. J. A. Holmes, chief of the fuel testing branch of the Geological Survey. "There seems to be no end to the gas and coal-dust explosions in mines. Instead of growing less, these horrors appear to be multiplying. On the first of this month, twenty-one men lost their lives in the Whipple Mine, in Fayette County, West Virginia, by an explosion of gas. This gives West Virginia a record of 103 lives lost in mine explosions during the first months of this year. On January 29 eighty-two men were killed in the Stuart Mine, also in Fayette County.

"In 1906, the coal mine death roll in Pennsylvania was 500. Two hundred and fifty died as the result of gas or dust explosions. The others were the victims of other accidents. We believe that this tremendous loss of life is unnecessary and it will be our purpose to investigate the subject in a most thorough and practical manner. We shall not be satisfied until we have reduced these accidents in coal mines to a minimum.

"From our investigations so far, the United States is behind Europe in safeguarding the lives of the men in the mines. England and Belgium have had for years splendid experimental stations, and in these countries there are but few casualties in the mines. The Belgium mines are notorious for the presence of fire-damp, yet that country has enjoyed a wonderful immunity from these terrible explosions.

"As a result of the experiments in England there are a number of 'permissible explosives,' and these must be used by the miners in the blasting of coal and no others. They also have in England what is known as the 'limit charge' which must not be exceeded on pain of severe penalty.

"In the various States here there are but few regulations, and none in many States when it comes to the kinds of powder to be used.

"While we cannot compel the adoption of regulations we will conduct the investigations and will give the facts to the public in the hope that great good may follow."

Officials of the Geological Survey have been watching with considerable dismay for some time the frequently recurring accidents in different parts of the country. Some of the recent mine explosions in one State, West Virginia, are as follows:

Mine.	*Date.*	*No. killed.*
Red Ash	March 6, 1900	100
Rush Run	March 18, 1905	24
Bluefield Coal Dale Mine	January 4, 1906.	22
Paint Creek, Detroit Mine	January 18, 1906.	18
Fayette County, Paral Mine	February 8, 1906.	22
Phillipi Century Mine	March 25, 1906	26
Fayette County, Stuart Mine	January 29, 1907.	82
Fayette County, Whipple Mine	May 1, 1907	21

Clarence Hall, explosive expert for the government, who has charge of the plans for the proposed experimental station, recently returned from England and Belgium where he examined the stations there. In these and other European countries, the mine owners, the miners, the government, and the manufacturers of explosives all co-operate in the effort to prevent the dreadful explosions. The results of these experiments go to show that a large number of the explosions in coal mines are due to coal dust rather than gas. The worst explosion that has occurred in Germany in the last few years was due to coal dust. Nearly two hundred lives were lost in the Reden Mines. Perhaps the greatest accident in many years occurred at the Courrieres mine at Pas de Calais, France, on March 10, 1906, when 1,300 lives were lost. This explosion was probably due to coal dust.

That part of the experimental stations in which the explosives are to be tested will be in the form of a cylinder, 100 feet long and 6 feet in diameter, lying on the ground. An explosive mixture of fire-damp and air in one case or coal dust and air in another will be pumped into the cylinder and the explosive to be tested will be shot into it from one end by a big steel mortar so that the flame and products of combustion will go right into the fire damp. If the station is erected within the Pittsburg coal district, natural gas will be used for testing purposes.

The cylinder is to be made of heavy boiler plate. Safety valves will be placed all along the top and will be left unfastened in such a manner that whenever there is an explosion, the valves will fly open on their hinges. A series of port holes on the side, covered with ½-inch glass, will enable those conducting the experiments to witness the explosions from the observation house, sixty feet away. The steel mortar which will hurl the explosives into the cylinder will be fired by electricity from the observation house, which is to be parallel with the cylinder itself.

While these tests are being conducted, operators and miners will be invited to be present. In order that they will be able to see clearly the explosions of gas or dust, a piece of oil paper will be placed across the face of one of the safety valves with a piece of gun cotton suspended about six inches away. When an explosion occurs, the flame will burn the oil paper and ignite the gun cotton.

While in England, Mr. Hall received courteous attention from Capt. J. H. Thompson, his Majesty's chief inspector of explosives. Capt. Thompson declares that although Great Britain was one of the most important coal mining countries in the world, gas and dust explosions had been reduced to a minimum by the precautions taken.

In Belgium, Mr. Hall witnessed also a unique test of safety lamps. The lamp which is used mostly in the mines of the United States behaved the worst and ignited the gas each time. A self-igniting lock lamp made in Germany proved the best. Belgium's experimental station was intensely interesting to Mr. Hall, the gas used in the tests coming from an abandoned coal mine.

At the rescue station there he found apparatus which is capable of sustaining life where there is fire-damp or among the poisonous vapors that follow the mine explosions. He hopes to have this apparatus introduced in this country, believing it will be the means of saving many lives. It consists of a canvas jacket equipped with cylinders of compressed oxygen connected with the operator's mouth by a flexible, rubber-lined metallic tube. The use of the oxygen is regulated by a pressure gage. The exhalation of the operator is passed through small lumps of potassium hydroxide, the carbon dioxide being absorbed, and the remaining product, together with more oxygen, is again available for the operator.

With this jacket on, in the event of an explosion, one could enter a mine immediately and undoubtedly save many from a terrible death by suffocation. At present no apparatus of such a nature is known to be in the United States. It would be the purpose, if the experiments are satisfactory here, to urge mine owners to keep these jackets in the mine and also above ground. The device will be given a thorough test in the miniature mine which is to be erected in connection with the experimental station. In this mine there will be drifts, headings, rooms, and ladders. After it is filled with smoke, miners will be instructed to enter and search as they would for their fellow-workmen.

When the most recent explosion occurred in West Virginia at the Whipple Mine, Mr. Hall visited the mine to learn if possible the exact cause of the explosion. The explosion occurred May 1 at 3:30 P. M., and Mr. Hall arrived on the ground within a few hours. In but a short time he learned that the explosion was the result of heavy blasting, which in itself was due to the hurry of two men to complete a disagreeable job. The men had struck a fault in the coal, and were going through a rock heading to get to the coal again. The men were being paid $2.50 per day while blasting away the rock, and as soon as they completed this work, were to be placed back at coal mining, which netted them between $5 and $6 per day. Hurrying through with their work, it is said they failed to undercut the coal, as it would take time. This in itself is against the laws of West Virginia. Blasting on the solid required a heavy charge of dynamite and this it is believed led to the explosion.

The explosion in the mine gathered force as it went along, for the reason that there was not enough air at the origin to cause a complete combustion. At a distance of 1,200 feet away, the greatest destruction was found. Altogether twenty-one men were killed and three injured. The two men whose hurry to get back to piece-work caused the explosion were found dead side by side, some distance from the scene of blasting, whither they had gone to await the outcome of the shot. Mules in one underground stable were found slightly burned, and in another stable they were untouched, only hungry. A mule in one of the passageways was found wandering about in the most disconcerted manner. His driver, who had abandoned him to make his escape when the explosion occurred, was found dead a short distance away. Had he remained with his mule, undoubtedly he would have been saved. The Whipple Mine, owned by the White Oak Fuel Company, is considered the best equipped in the State, and no one seems to attach any blame to the management for this explosion.

SCIENCE NOTES.

The excavations in Rome being conducted on the Palatine Hill have shown a curious and interesting circumstance. The Necropolis has been found to contain remains of the ninth, eighth, sixth, and fourth centuries before Christ. All fragments of the seventh and fifth centuries are lacking and archeologists are engaged in a close study of the field in order to find the reason.

A new compound of tantalum has been prepared by C. Chabrie, of Paris. The chloride of tantalum $TaCl_5$ is the only one which has yet been prepared, but it seemed likely that others existed, seeing that several inferior oxides of tantalum are now obtained. The author prepares a sub-chloride corresponding to the lower oxide Ta_2O_2 by reacting with the above-mentioned chloride upon sodium amalgam taken as a reducing agent. He places in a Jena glass tube a mixture of pentachloride of tantalum and a three per cent sodium amalgam. This mixture heats up spontaneously. It is brought gradually to a red heat after a vacuum is made in the tube. Cooling the mass *in vacuo*, we pour the contents of the tube into a capsule containing acidulated water, then filter and concentrate rapidly under pressure so as to avoid overheating. The solution, which has at first a dark green color, becomes lighter and deposits a green crystalline powder, and this is dried and examined. When seen under the microscope, the powder shows hexagonal crystals of a fine emerald green. Analysis shows the new body to have the formula $TaCl_2$, $2H_2O$. This compound is soluble in water when freshly prepared; it is but slightly soluble, however, and more so in hot solution. When left in the air the solid product is changed to a brown body, while keeping its crystalline form. Heated in air upon platinum foil it decomposes at a red heat with incandescence, giving off chlorine and leaving tantalic anhydride. The green crystalline body treated with nitric acid does not give tantalic acid, but a reddish brown powder which seems to be formed by an oxidation coming between the tantalic anhydride and the suboxide above mentioned. Nitric acid or bromine water transforms the green solution into a red liquid which tin chloride restores to the green color.

Up to the present, but a single combination of silicon and tungsten has been made. The two elements, heated in the electric furnace, give a compound of metallic appearance which is crystalline and hard enough to scratch the ruby. It corresponds to the formula Si_2Tu_2. M. Ed. Defacqz now succeeds in forming a new silicate of tungsten having the formula Si_2Tu. It is prepared by two different methods. In the first, silicide of copper is heated in the electric furnace with amorphous tungsten prepared by reducing tungstic anhydride by hydrogen at a red heat. We take 90 parts silicide of copper and 10 per cent of tungsten, heating for one minute with a current of 900 amperes and 50 volts. The metallic mass is then treated by nitric acid and soda, and we finally have a residue of small crystals, which form the new body. The alumino-thermic process can be also used, taking calcined silica 180 parts, tungstic anhydride 45 parts, flowers of sulphur 250, and powdered aluminium 200 parts. After igniting the mass in a crucible and cooling, we have a metallic ingot from which the new compound can be separated. As regards its properties, the silicide of tungsten appears in the form of fine prismatic needles, which are very brilliant and of a light gray color. Its density is 9.4 at the freezing point. It is non-magnetic. Chlorine attacks it easily at about 450 deg. C. forming chloride of silicon and hexachloride of tungsten. When heated in air to 900 deg. C. it is not changed. Copper decomposes it at 1,200 deg., forming silicide of copper and also tungsten. Gaseous hydrochloric acid has no action upon it at a red heat, nor most of the other acids. A mixture of hydrofluoric and nitric acids attacks it violently, leaving a residue after calcination of tungstic anhydride. Oxidizing mixtures such as alkaline nitrates and chlorates will dissolve it when heated above their fusing point.

THE LARGEST ARCH BRIDGE IN THE WORLD.

An important feature in the costly improvements being carried out by the Pennsylvania Railroad in and around New York is the building of a connecting railway for uniting the systems of the Pennsylvania Railroad and the New York, New Haven and Hartford Road. This connection will be made by means of a crossing of the East River, the most important feature of which will be an arch bridge (the largest in the world) of about 1,000 feet span. The plans for this bridge have been recently submitted to the Municipal Art Commission for its approval, in accordance with the franchise granted by this city to the company. The great steel arch will form part of a steel viaduct, itself the largest of its type in the world, the whole length of the structure, from abutment on Long Island to abutment in the Bronx, being 17,000 feet, considerably over three miles. With a wide, sweeping curve, the viaduct will pass over Hell Gate, Ward's Island, Little Hell Gate, Randall's Island and Bronx Kills. It will be not only the longest, but considerably the heaviest steel bridge in existence, over 80,000 tons of steel being needed for its construction. With its completion, the city of New York will find itself in possession of an all-rail route between New England and the South and West. Through trains from Boston may then run to New York, Philadelphia, Baltimore, and Washington, Palm Beach, New Orleans, Chicago, St. Louis, or any other southern or western city without leaving the rails. Hitherto cars for such through trains have been ferried around Manhattan Island from the Bronx to Jersey City.

The steel arch which will span the waters of Hell Gate will have a clear span between abutments of 1,000 feet, made up of twenty-three panels of about 42½ feet between centers. The depth of the truss at the ends will be 140 feet; at the center, 40 feet; and at the quarters 66 feet. The reverse curve of the upper member of the arch at either end is explained by the necessity of raising the top member of the portal to a sufficient height above the tracks to allow head room for the trains. At the quarters, the height has been purposely made such that no increase in the sections of the arch members is required to meet the bending strains due to one-sided loading. To this end the height, here, has been made greater than one-quarter the rise of the arch, which latter is 220 feet. From this it will be understood that the reverse curve of the top member of the arch is strictly the result of the contingencies of the design. The lower arch member has a section of 9 feet by 6 feet at the bearing and 5 feet by 5 feet at the center, the width decreasing evenly from the bearing to the crown. The struts are all riveted box sections, and the suspenders consist of eight heavy angles laced together.

The floor system is built on the customary method of heavy cross girders and longitudinal stringers. The floor beams are 8 feet in depth by 80 feet in length. The main arches are placed in vertical planes 60 feet apart, and the longitudinal portion of the floor system consists of eight lines of stringers, or two beneath each of the four lines of railroad track. Above the stringers is laid a solid wood floor of creosoted 8 x 8-inch timbers, packed tightly together, and calked. Upon this is 14 inches of stone ballast, in which are imbedded the cross-ties of the regular Pennsylvania Railroad standard track system. It should be mentioned here that the floor beams are the heaviest ever built for a bridge, the section of the bottom flange of the girders at the center being 6¼ by 24 inches, or 150 square inches.

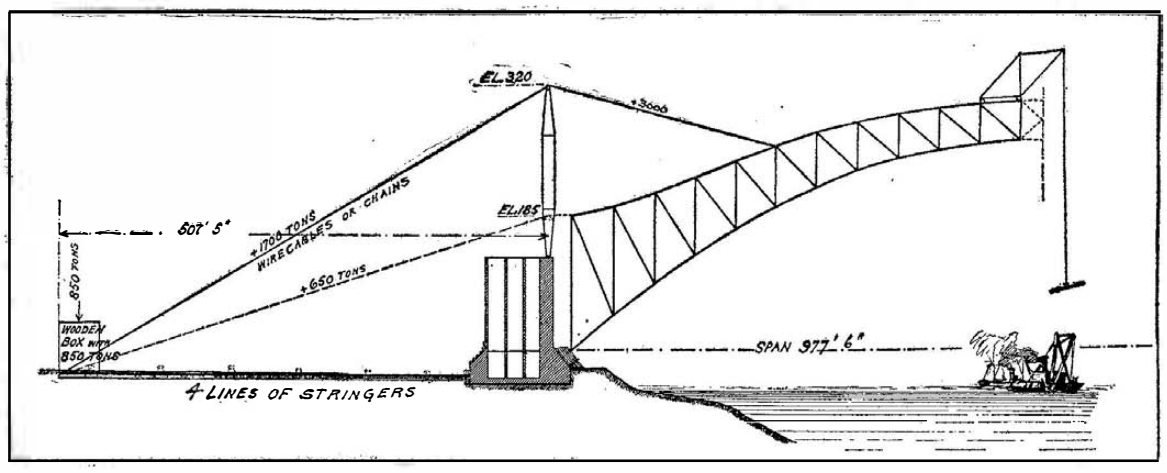


Diagram Showing the Arrangement of the Anchorage, Cables, and Rocker Tower to be Used in Erecting the Arch by Overhang.

Wind bracing is carried in the plane of the upper and lower arches from bearing to crown; but the main wind bracing is carried in the plane of the roadway, and it is arranged as a cantilever truss system. The contra-point and expansion joint of the cantilever are located six panels from each end of the arch; so that the temperature strains of the suspended floor system will in no way affect the arches—in other words, the temperature stresses of the arch and the floor have been made independent of each other. The maximum compression in the arch is found at the bearing, where it amounts to 16,800 tons, decreasing from that to 13,600 tons at the crown. This compression is that due to the combined dead and live load, wind pressure, and temperature stresses.

The abutments of the arch will be monumental stone and concrete towers, which will serve to divide the arch bridge proper from the steel viaduct which forms the approaches to it. The base of the tower will be built of granite; and it will rest on foundations of a very hard gravel at a depth of 20 feet below the surface. The upper portion of the towers will be built of molded concrete, and, as will be seen from our illustrations, the design of these towers is simple, massive, and dignified, and altogether harmonious with the design of the great arch itself.

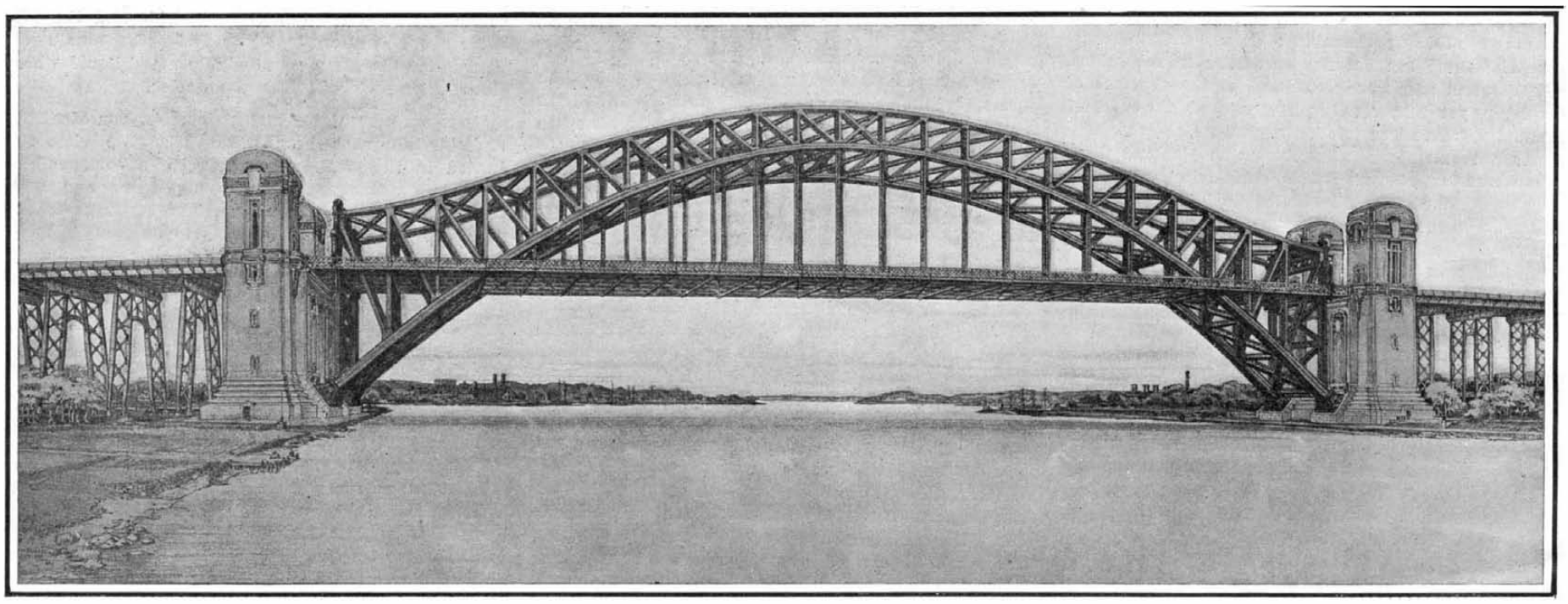
An interesting feature of this bridge is the method of erection, which will be carried through without the assistance of any false work in the whole 1,000 feet of its length. The arch will be built out in two halves simultaneously from each abutment, the steel work being guyed back to an original system of anchorage constructed in the following manner: At a distance of 507½ feet inshore from the abutment two huge wooden boxes or caissons, 12 feet wide, 42½ feet long, and 50 feet high, will be erected on the surface of the ground and each loaded with 850 tons of pig iron. Four lines of the stringers, which will subsequently be built into the floor of the bridge, will be laid in the planes of the arches in a straight line from each box to the abutment. Upon the top of the abutment will be erected two temporary rocker posts, and over these will pass the wire cables or eyebar chains, as the case may be, which will be used during erection to carry the load of the arches until they meet at the center of the span. The four lines of stringers will act as compression members, and prevent the movement of the dead-weight anchorages under the pull of the erection cable, which latter will reach a maximum figure, when the arches are well out to the center of the span, of 3,000 tons for each arch. The overhanging arches will be held against wind pressure during erection by means of two cables carried down to anchorages, on each side of the main abutment.

After the closure of the arch, the suspenders will be attached at their upper ends to the panel points of the arches, and to their lower ends will be riveted the floor beams. Upon the floor beams will be built in the whole floor system, with its stringers, wind bracing, wooden floor, etc.

The bridge has been designed to carry on each of its four tracks a load equivalent to two locomotives, each with a concentrated load of 52,000 pounds on each of the four drivers, the total weight of each of the two engines being 190 tons, followed by a train load of 5,000 pounds to the lineal foot. This would be equivalent to loading the whole of the four tracks from end to end of the arch with trains made up of heavy freight locomotives; and so stiff is the arch that under this load, the deflection at the center would be only three inches.

The three-mile viaduct will be made up of spans of from 70 to 100 feet, carried mainly on four-column rocker steel bents; but at every 800 feet of the viaduct there will be a massive stability pier of concrete, and also an expansion joint. It is estimated that the bridge can be built in two and one-half years, and at a probable cost of $12,000,000.

This handsome structure was designed by Mr. Gustav Lindenthal, the former Bridge Commissioner of this city, to whom we are indebted for assistance in the preparation of the present article.



Span 1,000 Feet, Width 81 Feet, Rise of Arch 220 Feet, Maximum Depth of Truss 140 Feet.

THE LARGEST ARCH BRIDGE IN THE WORLD. CROSSING EAST RIVER AT HELL GATE.

Gold Varnish for Gilding Picture and Mirror Frames.

a. 1,250 parts by weight of pale shellac, 500 parts of sandarac, 250 parts of gamboge, 175 parts of the palest red sanders, 130 parts of Venice turpentine, 5,000 parts of alcohol. *b.* 1,250 parts of pale shellac, 500 parts of sandarac, 5 to 8 parts of aniline yellow (or better, chinolin yellow), 175 parts alcoholized red sanders, 130 parts of Venice turpentine, 5,000 parts of alcohol. The coloring substances and shellac solutions to be filtered through filter paper, the resinous solutions, after settling a few days, to be passed through a closely-woven fabric. Each ingredient must be dissolved separately, then, after filtration or settling, mixed with the others, and the whole thoroughly stirred together.

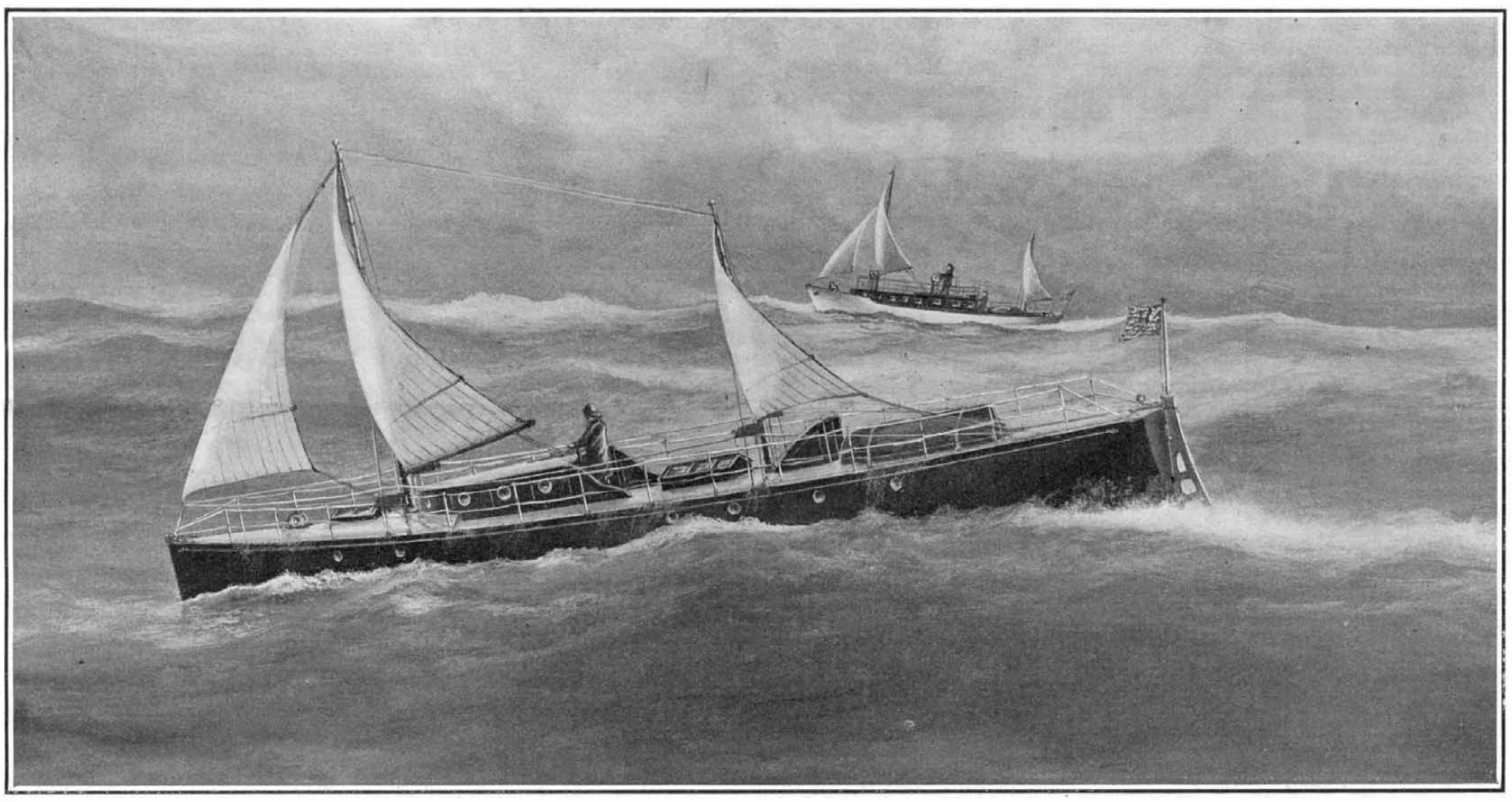
THE TWO COMPETITORS IN THE MOTOR BOAT RACE TO BERMUDA.

The first long-distance race for sea-going motor boats over the 700-mile stretch from New York city to the island of Bermuda starts upon June 8. A handsome $1,000 trophy was offered last fall by a member of the New York Yacht Club, but unfortunately there was not the response expected from owners of motor craft, and but two competitors will start in the race. These boats are shown in our illustration, which depicts in the foreground Mr. Eben Stevens's new 59-foot cruiser the "Ailsa Craig," and in the background, Mr. Peter Shields's 60-footer "Idaho." The former of these two boats was designed by A. Cary Smith, the well-known naval architect, and built by Purdy & Collison at City Island, while the "Idaho" was designed and built by Stearns & McKay, of Marblehead, Mass.

The "Ailsa Craig" should be by far the faster boat, as she is fitted with a 70-horse-power Craig, 4-cylinder, 4-cycle engine of 9-inch bore by 10-inch stroke, while the "Idaho" has a similar "Standard" engine of but 25 horse-power. The former boat's dimensions are as follows: Length over all, 59 feet 2 inches; length on water line, 59 feet; beam, 10 feet; draft, 4 feet 6 inches. The hull is constructed with four water-tight bulkheads, and there is a total sail surface of 320 square feet carried.

The principal dimensions of the "Idaho" are as follows: Length over all, 60 feet; length on water line, 53 feet; beam, 12 feet 3 inches; draft, 3½ feet. A total sail surface of 300 square feet is carried. This boat is a particularly comfortable cruiser, with a large cabin, engine room, and galley, and two good-sized staterooms. Her interior is finished in mahogany. She has a complete electric lighting outfit, and a powerful searchlight.

The race will start at 3 P. M. from the Motor Boat Club of America's station on the Hudson River at the foot of West 108th Street, and it is expected that the boats will finish some three days later at a stake boat off St. David's Head at Bermuda. The distance is 650 nautical miles. Although there are but two competitors, these should serve to demonstrate the usefulness of the motor boat as a sea-going pleasure craft, since these two pioneers have been designed and built for this special purpose.



THE TWO CRUISING MOTOR BOATS ENTERED IN THE RACE TO BERMUDA.

Automobile Notes.

Many automobile events were held on Decoration Day and the days preceding and following, both here and abroad. These consisted of endurance tests, hill-climbing tests, and track races, and the results of some of these events are given in the following notes.

Two hill-climbing contests were held on Decoration Day, one at Wilkesbarre, Pa., and the other near Bridgeport, Conn. The contest at the former place was the second annual one up the side of the Wilkesbarre Mountain. The course was 6,000 feet in length, with a total vertical rise of some 700 feet, the average grade being about 15 per cent. The fastest time up this incline was made by a Simplex-Peugeot motor bicycle, which covered the 6,000 feet in 1 minute 40 seconds, at an average speed of 40.9 miles an hour. The next best time was made by Mr. Walter C. White in his own steam machine, who covered the distance in 1 minute 49 4-5 seconds, thereby beating the best time made a year ago by 21 2-5 seconds. This time corresponds to an average speed of 37 1-4 miles an hour. The third best performance was that of a Stanley steam runabout, which made the climb in 1:56 4-5, at an average speed of 35.32 miles an hour. The best time made by a gasoline car was 1:59 2-5, which was the performance of a 60-horse-power Matheson. This corresponds with an average speed of 34.26 miles an hour. Two 30-horse-power Stearns machines obtained first and second places in the race for stock touring cars of all prices and horse-powers. The times of these two cars were 2:16 4-5 and 2:19 2-5 respectively. A 50-horse-power 6-cylinder Chadwick stock touring car made the climb in 2:02 3-5, while in the free-for-all a 60-horse-power Thomas was second in 2:01 1-5, and a 25-horse-power Pope-Hartford fourth in 2:06 4-5.

At the hill climb on Sport Hill, near Bridgeport, still faster time was made. This hill is a mile long. It has several rather sharp turns and an average gradient of about 15 per cent. A Stanley steam runabout made the climb in 1:24 2-5, and was tied by a 40-horse-power Locomobile of the 1908 type. This corresponds to an average speed of 42.65 miles an hour. The Stanley steam machines in both tests were driven by amateurs, while the gasoline cars were driven by experts. The Locomobile just mentioned was piloted by Joseph Tracy. Some of the best times made by other cars at the Bridgeport hill climb were 1:30 2-5 (39.82 m. p. h.) made by the new 70-horse-power Thomas runabout, and 1:32 3-5 made by the 50-horse-power 6-cylinder Stevens-Duryea. A Stearns and a Pope-Hartford car both came to grief at some of the turns. The cars were badly damaged, but the drivers and the spectators were not injured.

The Long Island Automobile Club conducted a 294-mile endurance test on Long Island on May 30 and 31. Twenty cars started and nineteen finished, ten with perfect scores. These were a Cadillac and Maxwell runabout and Columbia, Oldsmobile, Pope-Hartford, Matheson, Packard, Pope-Toledo, Pierce-Arrow, and Winton touring cars. Although the test was not a particularly strenuous one, since the roads of Long Island are noted for their smoothness, yet it is interesting to note that the cars which were penalized lost points for such insignificant troubles as carbureter adjustments, broken fan, and examining an engine. The only accident was that of a Haynes touring car, which skidded in making a sharp turn and broke a rear wheel.

The first endurance contest of the year to be held on the Pacific coast took place May 19. The start was made from San Francisco, and the test was made over a 98-mile course in San Mateo County. Thirty-four cars started, and fifteen of these, including two Reos, two Ramblers, three Buicks, a Maxwell, a Haynes, a Pierce-Arrow, a Glide, a Premier, a Studebaker, and an Elmore, secured perfect scores. The contestants were allowed to replenish their gasoline and water only once.

The third annual Tourist Trophy race was run on the Isle of Man on May 30. The roads were very bad on account of rain, and the contestants were therefore allowed an extra gallon of gasoline. There were twenty-two light touring cars in this race, and only two of them finished the 241.7-mile course on their fuel allowance. These were a 20-horse-power Rover, which won in 8 hours, 23 minutes, 27 seconds, at an average speed of 28.81 miles an hour, and the 16-20-horse-power Humber, whose time was 8 hours, 35 minutes, 17 1-5 seconds. Last year the race was won by a Rolls-Royce car at an average speed of nearly 40 miles an hour. But two of the heavy touring cars finished in the 201.42-mile race, which was held at the same time. These were a 30-horse-power Humber, which won in 7 hours, 11 minutes, 1 second, at an average speed of 28.03 m. p. h., and a 25-horse-power Gladiator, the time of which was 7 hours, 31 minutes, 35 1-5 seconds.

Demonstration of Vanadium Steel for Automobile Construction.

That the introduction of vanadium in the making of special alloy steels for automobile construction has created a mild sensation in metallurgical circles was evidenced by the presence of an even dozen of the most famous steel experts in this country at the plant of the United Steel Company at Canton, Ohio, recently, when the second heat of vanadium chrome steel was poured. This second heat was a world's record, inasmuch as it exceeded by 5 tons former heat of 40 tons, both of which were for the Ford Motor Company.

The experts watched the entire course of making the steel from the ore through all the various stages; then through the process of rolling, and finally forging into automobile axles. They were particularly pleased at the splendid manner in which the steel acted. Some of them had feared that difficulties would develop when it came to forging, similar to those which arise in forging nickel steel. This fear proved to be entirely without foundation. Not only could the steel be forged in one heat, whereas nickel requires fifteen to twenty, but the dies stood up as well under the work as in forging ordinary low-carbon steel. The finished product showed remarkably fine and uniform texture. A final analysis of the steel proved that the result was a success from that standpoint also, and that this 45-ton heat made in open-hearth furnaces is equal to the best that has ever been produced in the small experimental furnaces or crucibles.

In Ohio during 1906 there was one life lost for every 214,279 tons of coal mined, whereas in 1905 it was 226,628 tons, showing, states the Engineering and Mining Journal, the increased danger to which the miner of the present day is subjected, and the necessity for new mining legislation in order properly to protect those who work underground. There was one life lost for every 366 persons employed.

A Microscope for Demonstration.

BY DR. H. LEBRUN.

The great progress that has been made in microscopy within the last thirty years is known to the layman only by hearsay. Few persons except scientists and physicians have seen more than a glimpse of the new world revealed by the microscope, and popular ideas on the subject are vague and often erroneous.

A school may have a few microscopes, but it cannot afford to possess many of these costly instruments. As many slides as there are microscopes can be shown to a class. Then the slides must be replaced by others. I have devised means of obviating this tedious and unsatisfactory procedure and enabling each student to examine fifty microscopic preparations in succession without loss of time. One form of apparatus, employed for low powers, consists of a binocular microscope mounted on an American stereoscope box in which the slides are carried on an endless band and moved by turning a crank. The oblique top of the box bears two superimposed plates which can slide in directions at right angles to each other. The microscope, attached to the upper plate, can thus be brought over any point of the object. At the bottom of the box is a drawer in which the microscope and its accessories are kept when not in use. This apparatus permits a series of microscope objects to be viewed quickly and conveniently by many persons in schools, lecture rooms, museums, and exhibitions.

For powers higher than 70 I employ an ordinary monocular microscope with a specially contrived stage, and a number of objects mounted in a circle or a spiral on a single large plate of glass. I have devised a microtome which automatically deposits successive sections in the manner specified. The stage may be constructed either to bring the microscope over any particular preparation or any point of it by means of two mutually perpendicular sliding movements, as in the first type of apparatus, or to bring any desired point under the fixed microscope by the combination of a rectilinear and a rotary movement of the glass plate. In either case the movements are controlled and registered by graduated scales so that any point can easily be found again.

Convenience and economy of time and money are not the only advantages offered by these new arrangements. A very instructive series of related objects, such as the successive stages of development of a disease germ or successive sections of an embryo, can be arranged on a single plate, which will thus illustrate a whole organism or the entire history of a disease.

All these devices can be applied with equal advantage to projection microscopes.—Translated for the SCIENTIFIC AMERICAN from Umschau.

Factors of Safety—or of Ignorance.

BY DR. JOHN BESSNER HUBER.

The student of biology discovers an expenditure of cosmic forces far beyond the requirements of sentient creatures. Nature is never a niggard; but is on the contrary amazingly extravagant in her provisions. The roe of a single fish, for instance, contains oftentimes millions of potential fish lives of that particular species. Medical history furnishes countless instances of such physical endurance as argues enormous reserve potentialities. The flagellants were, under stress of intense emotions, able to submit to most dreadful scourgings, such as one would in our day consider impossible to be survived. In those mental epidemics in the middle ages when the victim danced, there were swaying circles which, during many hours together, manifested strength hardly conceivable to us moderns.

In times quite modern the "Convulsionnaires" were wont to bend their bodies in bridge fashion, and to permit very heavy weights to be dropped upon their tense abdomens. Lying thus they could bear planks having several men sitting upon them.

Who is not thrilled in reading how Napoleon led his army across the Alps, to the point where his troops believed themselves absolutely spent; not another step could they carry their panting bodies. But here that magnificent, though untutored, psychologist had his band play "La Marseillaise." Its strains amid those snow-capped heights were a mighty stimulus to courage and patriotism, whereby such reserve strength was awakened as the rank and file had not dreamed themselves possessed of; so that with triumphant shouts they finished the titanic task their general had laid upon them.

The saying, "the half of his strength he put not forth," argues a latent potentiality which is the secret of the influence that many notable men are able to exert. It is in every one's experience that under stress of fright or under the inspiration of great affection or other tremendous emotion, things have been accomplished of which one would never have imagined himself capable. And physicians especially know that most men and women complete the span allotted to them by Nature, despite the many diseases, despite accidents and other untoward circumstances to which they are during their lives subjected.

There are, then, in our bodies forces in reserve, often unsuspected, which avail in times of undue stress and strain, and by means of which a fairly normal condition is preserved despite many inimical agencies. This must have been realized from time immemorial by observing physicians; but probably no very scientific recognition has ever been taken of the matter until Dr. S. J. Meltzer recently addressed the Harvey Society of New York city on "The Factors of Safety in Animal Structure and Animal Economy."*

Meltzer borrows the term "factor of safety" from the mechanical engineer, who thus designates the margin of safety required in constructing engines, bridges, houses, and the like. If, for instance, the tensile strength of boiler steel plates and stay bolts is 60,000 pounds to the square inch, the actual stress which is allowed for the work of the boiler should not be more than 10,000 pounds per square inch for the plate and not more than 6,000 pounds per square inch for the stay bolts—which means that the stress to which the plates may be exposed in the boiler should be only one-sixth or one-tenth of the actual strength of the steel. The factors of safety are here said to be six for the plate and ten for the bolts. In mechanics, then, it is calculated that the structures should be capable of withstanding not only the stresses of reasonably expected maximum loads, but also those of six or seven times such loads. The factor of safety is founded upon finite human ignorance of what might happen, and upon a wise and very praiseworthy desire to provide against such contingencies. Wherefore these factors are oftentimes termed factors of ignorance. And, with regard to the human machine, the latter term would seem rather the preferable one. For this machine is, by comparison with those constructed out of inorganic materials and worked by men, of complexity quite infinite. It is, of course, much more difficult to foretell the possible strain, the stress of environment, accidents, the attacks of parasitic organisms, and the myriad other agencies hurtful to the human machine, many of which we are powerless to prevent, concerning many of which we are in ignorance—ignorance, we are however proud to say, which is yearly becoming more and more dissipated.

Improving the Liverpool Channel.

To keep the Crosby channel in a navigable condition, Liverpool is now annually expending $150,000 in dredging and $50,000 additional is required for dredging at the landing stage to enable the great ocean-going steamers to proceed alongside the stage to disembark their passengers. The original provision called for a minimum channel depth at low water of 36 feet. Most of the large Atlantic liners draw approximately 30 feet. Sand accumulations have reduced the channel depth at low water to 28 feet, and several large steamers have recently grounded. The dock board, recognizing the danger to navigation and anxious to remove the obstruction, has decided to expend a large amount of money for the construction of a training wall on the south face of Taylor Bank.

The training wall will be nearly two miles long, and will consist of huge blocks of concrete, requiring several years to complete and many thousands of tons of stone and cement. The object of the wall is not only to prevent the narrowing of the channel, but to produce a sufficiently powerful scour to do away with the accumulations of sand patches. The engineers who are to execute the work believe that the flood tide in striking the western portion of the wall and curving with the wall sharply to the southward and eastward will eat away the northern portion of Askew Spit, and that the ebb tide in striking the southeastern portion and following the trend of the wall will assist materially. It is also believed that the western portion of Taylor Bank will be cut away. If the training wall fulfills the anticipation of its designers, a very much straighter and a considerably deeper channel will be provided, and the facilities for navigation will be greatly improved.

Interesting Tests with an Automobile Spark Coil.

Some interesting experiments were made recently in England in connection with a test of a synchronized ignition system employing a single spark coil with vibrator for use with a 6-cylinder motor. A 6-volt battery was used in order to compensate for the extra resistance introduced in the circuit in the form of a hot-wire ammeter. The first peculiarity noticed was that the current consumption increased from 1.42 amperes at a commutator speed of 200 R. P. M. to 1.62 amperes at a speed of 1,000 R. P. M. (or 6,000 contacts per minute). At still higher speeds it diminished, as one would naturally expect it to do, the consumption at 1,400 R. P. M. being but 0.98 ampere.

Another interesting fact discovered was that at 900 R. P. M. of the commutator (corresponding to 1,800 of the engine) the vibrator ceased to operate, and but a single spark was obtained at each plug when the circuit was broken at the commutator. At this speed the commutator was making 90 contacts per second. As at a commutator speed of 500 R. P. M. and a current consumption of 1.5 amperes the vibrator is stated to have made from 150 to 160 vibrations per second, or 3 vibrations for each contact, it can be readily seen that a point would soon be reached where the vibrator would make only two and then one vibration per contact, and finally none at all. Thus it can be seen that by making the contacts short enough and using a single coil with vibrator, the vibrator will automatically cease working at high speeds, and the simplicity of a coil without vibrator will be obtained. It might be necessary to fit a second condenser to take care of arcing at the contacts, however.

A test was made to ascertain the maximum commutator speeds with which a regular succession of sparks could be obtained at the plugs when the latter were submitted to different compression pressures. These were found to be 1,600, 800, and 160 R. P. M., with compressions of 70, 110, and 150 pounds to the square inch respectively.

In order to show that the spark coil would stand a high temperature, it was placed in an oven and gradually raised to a temperature of 180 deg. F. After two hours' submission to this heat test, the coil would still work, although it gave a somewhat attenuated spark. At ordinary temperatures, the insulation resistance between the primary and secondary windings was found to be 0.2 megohm with a testing pressure of 200 volts.

* The Harvey Society Lectures. (The Lippincotts.)

The Agassiz Centenary.

A few weeks ago the birthday of Audubon was celebrated—perhaps the keenest and most loving observer of birds and quadrupeds our land has known. On May 23 the world commemorated the second centenary of Linnæus, the founder of modern botanical science and of nature study in the vegetable kingdom. On May 27, Harvard University celebrated the centenary of the birth of Louis Agassiz, who must be ranked among the foremost nature students and nature teachers of all lands and times. The exercises were held in Sanders Theater, with Col. Thomas Wentworth Higginson as the presiding officer. Col. Higginson gave a short address, filled with personal memoirs of the naturalist and teacher, and was followed by President Eliot.

Other speakers were Prof. A. Lawrence Lowell, of Harvard; Dr. J. C. Gray, of the Harvard Law School, and Prof. W. H. Niles, of the Massachusetts Institute of Technology. A number of letters, written by Agassiz to former pupils, were read by Prof. J. L. Winters, of Harvard, and there were also readings of poems on Agassiz written by Longfellow and Whittier.

On May 30 a tablet in Agassiz's honor was unveiled in the Hall of Fame for Great Americans—one of only three thus far given to Americans of foreign birth. He is worthy of that honor, and of remembrance and emulation by every one who prizes a knowledge of the truths of natural history and of the principles upon which the material world is ordered.

Nature lovers and nature students, who nowadays seem to comprise about ninety-nine one-hundredths of the community, might well regard the present month, especially in the present year, with peculiar interest.

Artificial Copper.

Dr. Ira Remsen, president of Johns Hopkins University, according to newspaper reports, is authority for the statement that Sir William Ramsay has discovered a method of making artificial copper, and that the great discovery will be made known to science when Sir William will read a paper on the subject before the Royal Chemical Society of Great Britain.

Prof. Remsen has a private letter from the famous Englishman, stating that Sir William has succeeded in accomplishing what no other chemist has ever been able to do—the segregation of one element from another and the production of copper by the synthetic or combining process from the elements sodium, lithium, and potassium. A combination of these elements when treated with radium vapor gives as a product copper sulphate, which is readily "broken down" into copper. Such is the substance of his experiments. The discovery, if true, is of so startling a nature that we must withhold judgment until the publication of Sir William Ramsay's paper. This brief preliminary note is published merely for what it is worth, and not as a verification.

Oil, states Power, is not a fuel that is, so to speak, indigenous to this country. Yet if all our bituminous coal were properly utilized by the extraction of the by-products, it is possible that there would be a large available supply of tar, which is an excellent liquid fuel. Oil fuel needs no manual labor, and men tired out with firing coal many hours on stretch can be replaced by mechanically-supplied liquid fuel. It is not surprising, therefore, that the admiralty are having built at Chatham three 500-ton oil fuel lighters for service at Sheerness, pending the erection of four 5,000-ton steel oil tanks for the Medway.

Correspondence.

Another Letter on Repairing Broken Shafts.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the article in the SCIENTIFIC AMERICAN of March 23 entitled "A Quick Method of Repairing Broken Shafts," the writer would suggest that a tapered stud be used instead of a straight one. This would give more nearly the full strength of the shaft, and would make a joint such as is used on drilling tools for oil wells. These joints are known to be very strong, and to stand hard usage. If then after this joint is tightly made up, holes are drilled around it, and steel pins driven in, keying it together, it is doubtful if it would ever show weakness. Although the writer has never had experience in work of this kind, he offers this suggestion for what it may be worth.

A. B. CARLL.

Boothwyn, Pa.

A Curious Accidental Welding of Steel Shafting.

To the Editor of the SCIENTIFIC AMERICAN:

A very curious accident occurred recently in a large cotton mill near Moscow. From a steam engine of nearly 1,500 horse-power, 350 horse-power is transmitted by ropes to one of the stories of the mill. The driven shaft makes 320 revolutions per minute.

The main shafting in the rope drive is arranged according to the accompanying sketch, the power from the flywheel being transmitted by ten ropes to the rope pulley on the first shaft, then by a pair of bevel wheels to the second shaft, and then by a Wüllfel's friction clutch to the third shaft, and from the rope pulley on this shaft to the rope pulley on the line shaft in the mill.

By some mistake of the fitter, the second shaft was put too close to the third shaft, so that it touched the latter, and all the pressure from the bevel wheel was transmitted directly to the end of the third shaft.

One Saturday morning the first bearing on the third shaft, *a*, became warm. The engineer, wishing to cool it, loosened the clutch and thus stopped the third shaft. Thus all the pressure from the rotating second shaft became applied to the end of the third shaft. Both shafts have the same diameter, 170 millimeters (6¾ inches).

As the pressure from the bevel wheel on the shaft was considerable, and the shaft was making 320 revolutions, in a few moments the touching ends of the two shafts between the two halves of the clutch were heated, not only to a red heat, but to the welding point as well, so that the liquid iron spurted to the walls. The engineer became very much frightened and signaled to stop the engine, and thus both shafts became completely welded together.

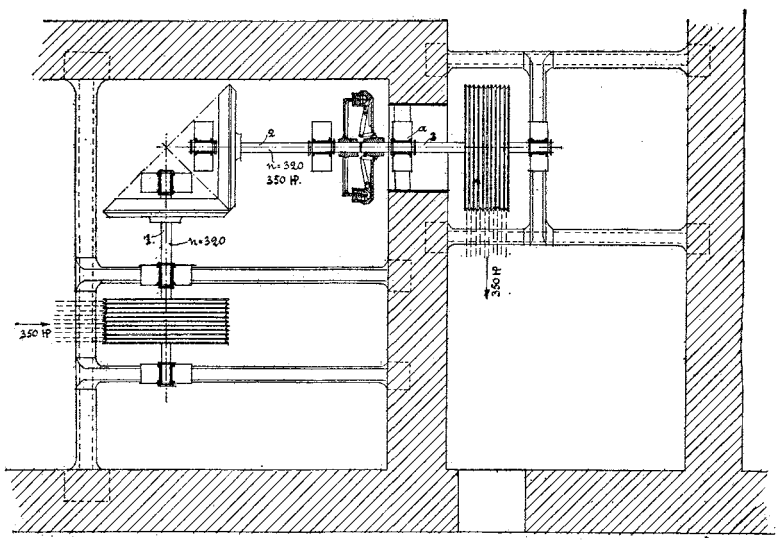
After the shafts were cooled, the engine was started again, but both shafts revolved together, notwithstanding that the friction clutch was open. The bearings did not become heated, thanks to the fact that both shafts were welded in exact alignment, so the mill was run till night, and all the usual machinery working from this shaft and taking 350 horse-power.

Next Sunday the shafts were lifted by their free ends, together with the bevel wheel, the clutch and the pulley, and though they weighed some tons, the welded joint did not separate. So it was decided to leave them in the welded state till the new shafting is ready.

Since that time, for more than a month, the shaft has been working satisfactorily with opened clutch, transmitting all the power without difficulty.

P. N. BOCKAROFF, M.E.

Mockba, Russia.



A CURIOUS ACCIDENTAL WELDING OF STEEL SHAFTING.

The Salvage of Ships.

To the Editor of the SCIENTIFIC AMERICAN:

It may be considered presumptuous in a layman to make suggestions in the matter of naval construction, but I cannot recall that I have seen any such method described in any scientific or other publication as the one I am submitting in this communication. The branch of construction to which I propose to refer does not cover either the actual designing, model, or machinery of ships, but relates solely to the salvage of the vessel in the case of accident by collision or running aground. In modern construction, I understand that ships are built with numerous watertight compartments, any two of which may be filled without resulting in serious danger to the vessel. This system is certainly a good one, and has been proved so in many instances, while in others it has not had the effect of saving the vessel from total loss. The scheme of construction I would advocate is merely an extension or improvement on the present system, and I claim would have the effect of saving many vessels that, under existing circumstances, would be totally lost.

As a solution, to some extent, of the problem of rendering vessels safe from damage or total loss through collision or grounding, I would suggest, in the first place, that the main deck or first deck above the load waterline of every passenger steamship, battleship, and cruiser should be built airtight and of sufficient strength to sustain a pressure of air below that deck that would keep the vessel afloat, even if the bottom were perforated alongside the keel in every compartment. That would mean, of course, that the deck would have to be so built that every opening could be hermetically sealed, so to speak, and in the shortest possible time. Each compartment should be separate and independent of the other. Each of the compartments should have an airlock, on the same principle as those used in the construction of the North and East River tunnels in New York city. A gang of locomotive air-brake pumps should be installed above the safety deck, operated by gasoline motors, so that they would be wholly independent of the ship's power—of sufficient capacity to fill any one or all the compartments with air within a short space of time. By these means, easy and safe access could be obtained to any compartment, and repairs made to the damaged part of the vessel. Further, each one of the compartments should be supplied with an electric light system and a telephone system, controlled and operated from a central point. A vessel equipped in this manner would be practically unsinkable, unless broken in two or the plates strained in every part of the ship so that the air pressure could not be maintained; and even in the former case, if each half of the vessel had its full complement of air pumps and other appliances, the two halves could be kept afloat independently, but, of course, the propelling power would be available only in one portion. The additional expense entailed by this mode of construction would be comparatively small.

Take the case of the Allan steamship "Bavarian," recently floated in the St. Lawrence River by means of pneumatic pressure. The cost of the vessel was over $1,000,000. She was sold by the underwriters, I understand, for about $30,000. That amount, I estimate, would fully cover the cost of installing the appliances I have suggested herein; but assuming it would be $100,000, it would be well worth expending to insure the safety of a vessel of that class. No vessel, large or small, that traverses the ocean is immune from danger by striking derelicts, icebergs, collision with other vessels, or running aground in foggy weather or in heavy snowstorms, when lights are obscured and the reckoning cannot be ascertained, in approaching a dangerous coast.

Provision should also be made for the installation of check valves, relief valves, and air gages both inside and outside of each compartment, in order that persons working under air pressure could regulate the supply of air as circumstances might require.

It would appear to me that sliding doors should be used, instead of swinging doors, in all partitions below the airtight deck, and that these doors should be kept closed except when not actually in use, and that horizontal sliding doors should be used to close apertures or hatches in the safety deck. A system of indicators might be installed in the central telephone and electric light switchboard room which would show, at all times, the position of the vertical and horizontal doors in each compartment; that is, whether they are open or closed.

I have not gone into any calculations with regard to the air pressure that would require to be developed, but I would estimate, roughly, that it would be very much below thirty pounds to the square inch.

I venture to prophesy that not one vessel in a hundred equipped in this way would become a total loss in case of accident, without taking into consideration what is of greater importance, the saving of human life.

J. E. W. CURRIER.

Ottawa, Canada.

The Orbit of the Sun and the Solar System.

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of your valued periodical for April 20, 1907, a letter from a correspondent is printed under the title "The Orbit of the Sun and the Solar System." It would seem to be well to examine the statements of this letter, to see what basis there may be for them in the work of astronomers. The larger portion is a quotation from an article "in a local publication." Of course, there is no objection to "newspaper science" when it is true.

The writer quoted is certain that we are traveling toward the star Arcturus, and with a speed of about 5,000,000 miles a year. He states that we shall be near enough to that giant star to experience its awful heat in about 25,000 years, and in about 75,000 years more we shall be near Polaris, at the other end of the solar orbit, where are "thrilling regions of thick-ribbed ice." These transitions are to be repeated, we presume, forever. This is all interesting, if true, but the most careful researches of astronomers do not give one scintilla of evidence in its favor.

Now, as to the speed of the sun in its path, astronomers are agreed that this is about 12 miles a second. At this velocity, which is a slow one as velocities go in the heavens, we go 1,036,800 miles a day, as any one can determine by multiplication, instead of 5,000,000 miles a year, as the writer states, and nearly 400,000,000 miles a year. Yet the stars are so remote that the sun will require 68,000 years to cross the space separating it from the nearest star at this enormous rate of motion. Again, astronomers are agreed that the sun is moving toward Vega, and not Arcturus, and that it will require the sun 558,000 years to pass by Vega. But we shall never pass by Vega, although we are moving toward it, nor would we pass Arcturus, if we were at present moving toward that star, since these stars are themselves moving, and will not be where they are now when the sun gets where they are now. They will be far away from the places they now occupy. Let us see how long it would require the sun to travel to the place where Arcturus now is. The parallax accepted for that star gives its distance such that light requires 160 years to come to us from him, and that we should go to him will require nearly 2,500,000 years at the rate of 12 miles a second. In the light of such figures a period of 75,000 years becomes a mere point of time, a watch in the night.

The determination of the point in the sky toward which the sun is moving is a matter of much interest to astronomers, but it is one on which no more than a beginning of investigation has been made. Herschel, more than a hundred years ago, studied the proper motion of the stars, and located this point in the constellation Hercules. Many others of the highest repute, including Struve and our own Newcomb, have followed Herschel, and have reached a slightly different result, although they do not remove the point very far from Hercules. It is now located near Vega in the constellation Lyra, or by Campbell at a spot 10 deg. south of this star. The opposite point is near Sirius, and not near Polaris. Any one who is interested in this investigation will find a statement upon it given in Moulton's "Astronomy," the latest and best textbook for students beginning the subject.

WILLIAM C. PECKHAM.

Adelphi College, Brooklyn.

The Current Supplement.

The exhaustive paper by Prof. Alexander Graham Bell on "Aerial Locomotion," which has been running in the SCIENTIFIC AMERICAN SUPPLEMENT, is concluded in the current issue, No. 1640. In this installment Prof. Bell compares Hargrave box kites with tetrahedral kites. Mr. S. E. Worrell writes on "Recent Improvements in Machinery for Drying Different Products." An abstract is published of the paper read before the Royal Institution by Prof. H. A. Miers on the "Birth and Affinities of Crystals." "Artificial Fertilizers: Their Nature and Function," is the title of a splendid discussion of an ever-timely subject by A. D. Hall, director of the famous Rothamsted experimental station. Dr. George A. Soper writes on "The Sanitary Engineering Problems of Water Supply and Sewage Disposal in New York city." Since the invention of wireless telegraphy many attempts have been made to transmit to a distance mechanical effects, as well as telegraphic messages, without the use of conducting wires, and thus to operate mechanical devices wherever situated. Dr. Alfred Gradenwitz gives a review of various systems which have been proposed to accomplish this end. "Artificial Fireproof Stone" is the title of an article giving much practical information. Victor Quittner discusses modern methods of photometry. In 1879 Prof. George H. Darwin propounded the view that the moon formerly formed a part of the earth. Accepting this theory, Prof. William H. Pickering has sought to ascertain the place of origin of the moon on the earth.

MINING IN NEWFOUNDLAND.

BY DAY ALLEN WILLEY.

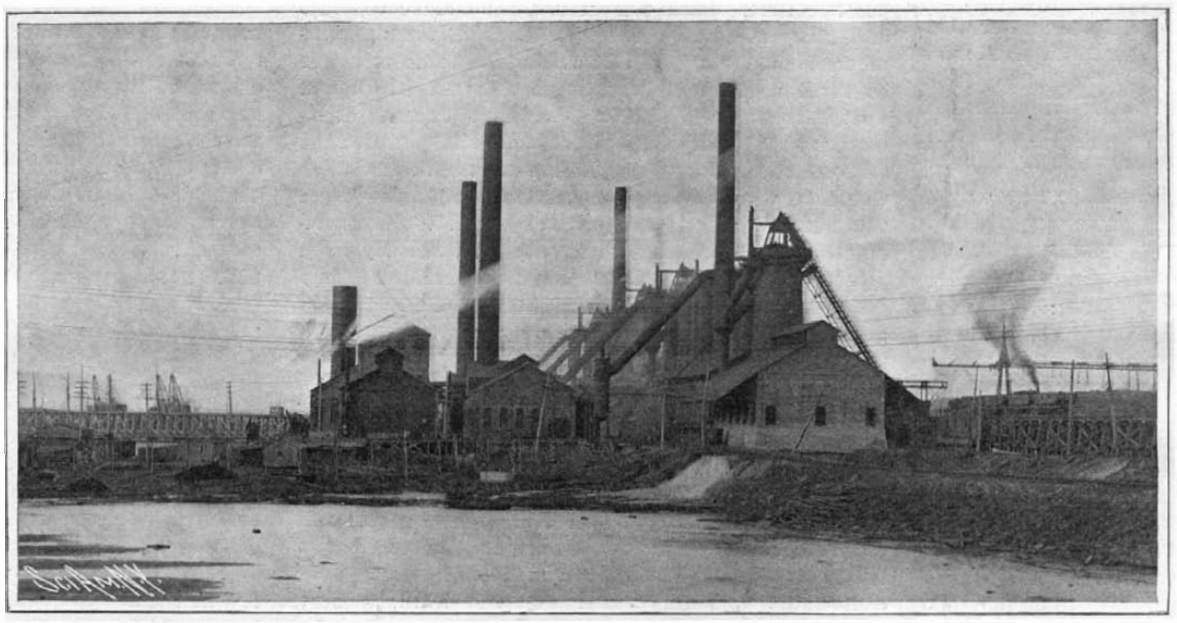
The extent of the Newfoundland fisheries, in which such a large proportion of the inhabitants of the colony are employed, may have caused the importance of its mineral industry to be overlooked to a certain extent. As a matter of fact, however, recent investigation has shown that deposits of copper and iron ore in various forms are so extensive that the island promises to contribute a very large percentage of these metals to the world's supply for an indefinite period. While gold-bearing quartz as well as lead and silver ores have been found in various parts of the island, the accessibility of the iron and copper deposits has caused attention to be confined to these almost entirely. The mining of copper has been carried on about forty years, but only recently have the beds been worked on an extensive scale. The principal center of the industry is in the vicinity of what is known as Tilt Cove, near Notre Dame Bay, on the northern coast. There are four mines adjacent to Tilt Cove, named North, East, South, and West respectively, according to their situation from the town itself. The East mine thus far has been the greatest producer of this group. About 15 miles distant, at Bett's Cove, another bed of ore is now being worked, which is apparently of considerably larger dimensions, while another extensive body is located at what is called Little Bay.

At each place the ore is so near the surface and in such a formation that mining has been attended with little difficulty, and the tonnage secured at a very low cost. In some instances the copper has been obtained by lateral excavations, and the bulk of it is secured by means of tunnels and shafts, few of which are over 100 feet in extent. In the industry at Tilt's Cove several shafts have been sunk vertically, and the mineral secured by lateral galleries opening into these, the mining being done mostly with pick and shovel. The ore is raised to the surface by means of large buckets attached to cables wound on drums. It is then emptied into tramcars and hauled by animal power to the ore docks. At some of the ore mines the deposits are so near the docks, and at such an elevation above them, that the loaded cars can be carried to the vessel's side by gravity, being hauled back by a cable system.

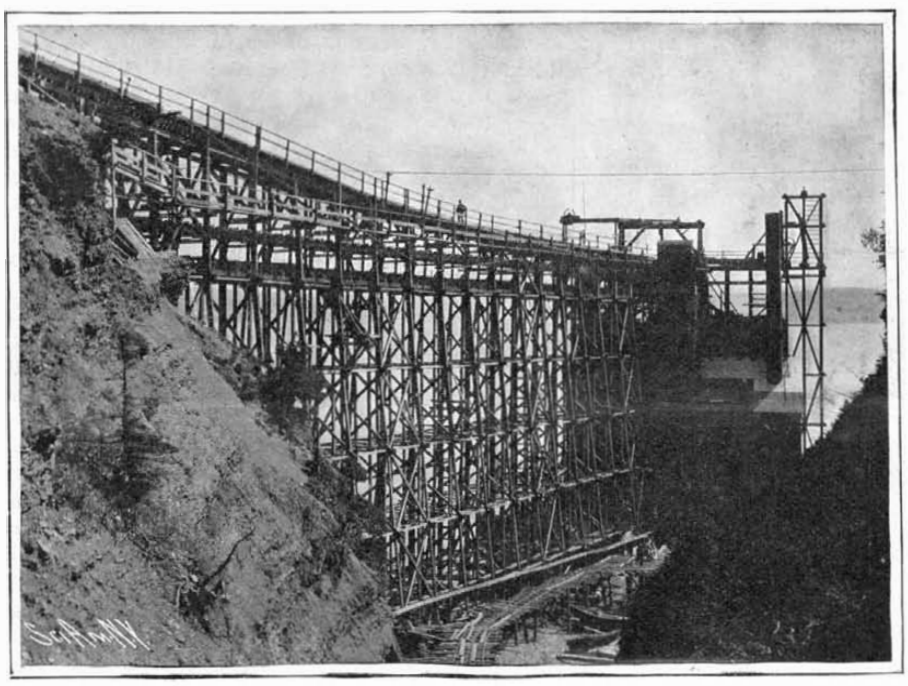
At present the output of the three localities referred to ranges between 75,000 and 85,000 tons of ore annually. None of it is smelted in Newfoundland, about half being shipped to England and half to the United States for this purpose. Nearly all of the deposits are found in the serpentine formation, and are in the lower Silurian series of rocks. The ore occurs, however, in a chloritic slate, which lies parallel to the serpentine rock. The ore assays as high as 12 per cent of pure metal, and the veins have been traced a distance of 40 miles in the Notre Dame region.

It is an interesting fact that the iron-ore deposits, which have been worked on a considerable scale, are located on islands in the bays which indent the coast of Newfoundland. By far the most notable is Belle Isle, in Conception Bay, a few miles from St. John's itself. The island is about six miles long and three in width, and apparently is made up almost entirely of brown hematite. The formation is very similar to that of the Michigan iron ranges, since it is close to the surface and is revealed by stripping off the few feet of the earth and rock which cover it. In fact, much of the deposit has been laid bare merely by using the pick and shovel. When broken out with hand tools it separates in the form of rhomboids, and but little force is required to reduce it to the size suitable for handling. Mining operations have been conducted in Belle Isle for about ten years, and at the outset such a large quantity was secured by hand labor that at times a thousand tons were carried to the shipping point in a day. By the installation of drills operated by compressed air and electricity and mechanical loading apparatus, the mining capacity has been largely increased, but as yet such a large body of ore is still near the surface that it has been unnecessary to do any tunneling whatever.

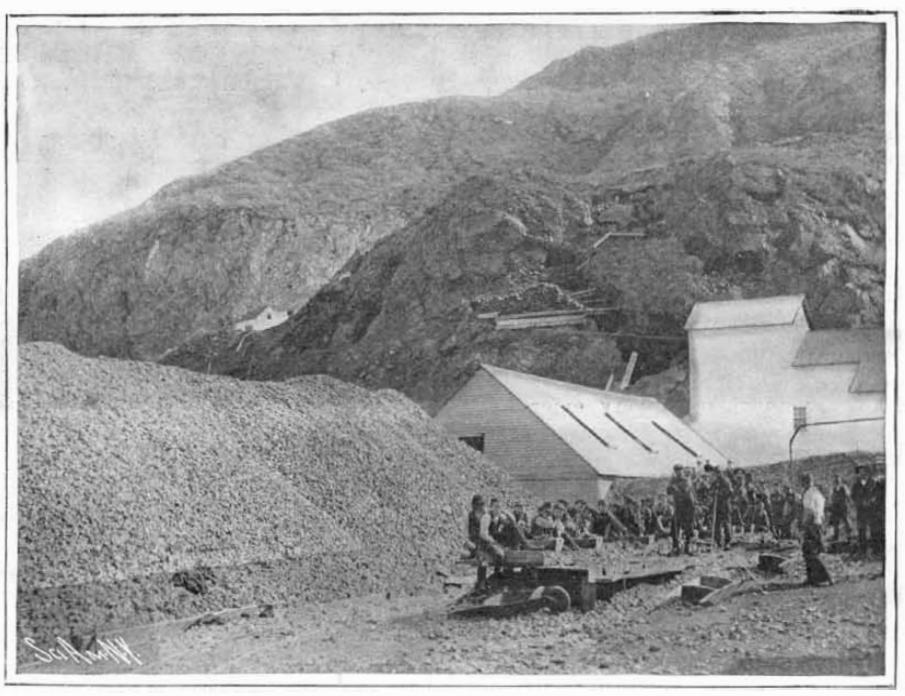
An estimate of the ore near the surface on Belle Isle places it at nearly 30,000,000 tons. The output at present averages about 400,000 tons annually, nearly all of which is sent to Nova Scotia, where it is smelted at the furnaces of the Dominion Steel and Coal Company at Sydney. As fast as loaded, the mine cars are



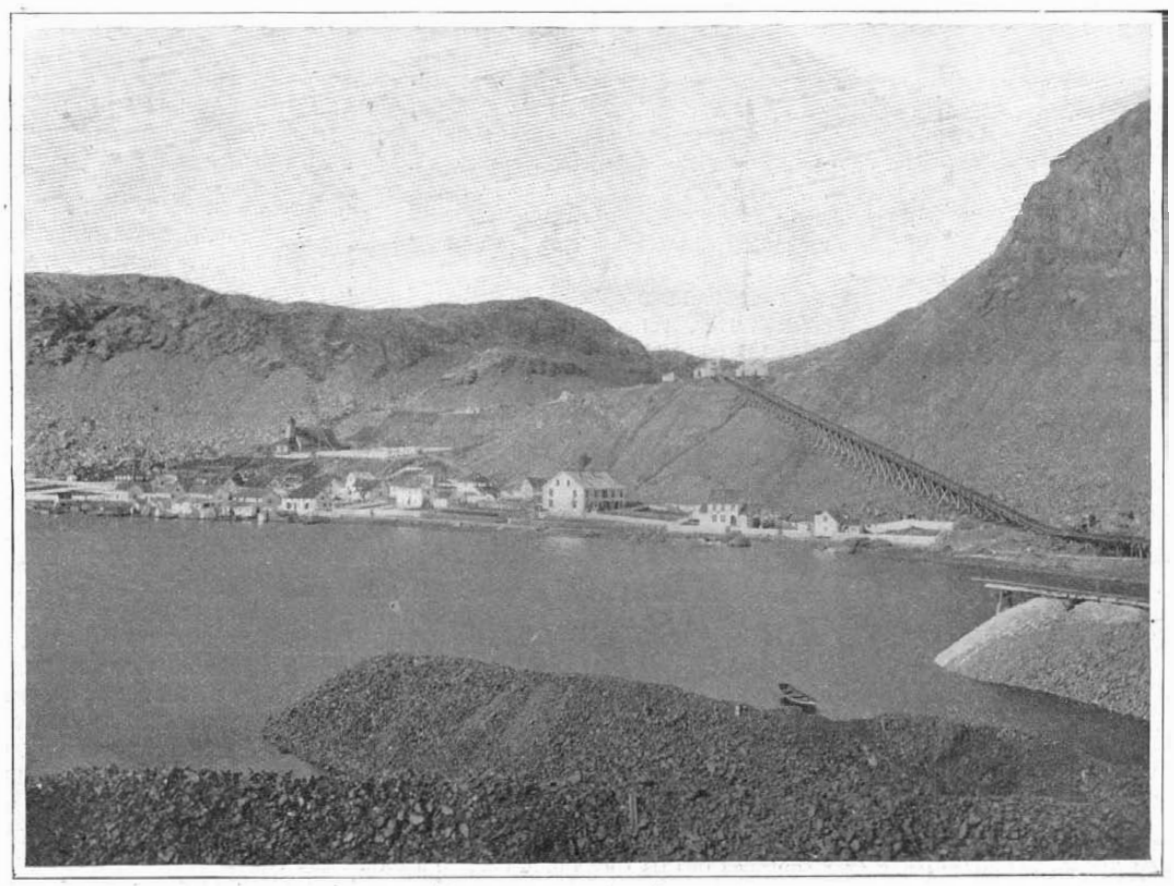
Blast Furnace Plant Smelting Ore from Newfoundland.



Iron Ore Shipping Pier at Belle Isle. The Ore is Shipped to England and the United States to Be Smelted.



Piles of Broken Ore at Tilt's Cove Awaiting Shipment. In the Background Can be Seen the Crude Galleries Excavated by Hand, Opening Into Copper Deposits.



Bird's Eye View of Tilt's Cove, Showing Piles of the Ore in the Foreground Awaiting Shipment, the Tramway for Hauling Ore from the Mines, the Village, Also the Copper-Bearing Cliffs in the Rear of the Village.

hauled to chutes built out from the shore line, where the water is sufficiently deep to float a 10,000-ton steamship. The usual method is to run the cars out upon the trestle extending along the top of the chute, and dump directly into the hold. It may be added that the tramway from the mines to the water side is so inclined that but little power is required to transfer the loaded cars to the chutes. From 4,000 to 10,000 tons daily can be loaded at this point, and during the shipping season, which covers about five months of the year when the bay is ice free, a fleet of ten or twelve ore carriers is continually plying between Belle Isle and Sydney.

The ore at Belle Isle contains from 48 to 56 per cent of pure metal, and yields a pig iron especially suitable for rail and structural steel, into which much of it is manufactured. The furnaces of the Dominion Company which are of modern design will smelt from 1,200 to 1,500 tons of ore daily.

The mining of iron pyrites is conducted on an extensive scale at Pilley's Island in Exploits Bay. As the photograph shows, the deposits outcrop on the shore of the bay so extensively that most of the mining is done with hand tools, the formation being very soft. In a few places lateral galleries have been driven into the beds, but a very large tonnage is situated directly on the surface. At present Pilley's Island is yielding nearly 75,000 tons yearly, most of which is carried to the United States for reduction. An analysis of the ore shows that it contains between 50 and 60 per cent of sulphur, which is secured in the treatment, while the metallic iron is utilized in the composition of a high grade of steel.

As in the case of the copper deposits, the iron ore beds, especially in the eastern section of Newfoundland, are undoubtedly very extensive, for veins have been traced along the shore of Conception Bay a distance of over fifty miles. The quantity and accessibility of the Belle Isle deposit, however, has caused the industry to be principally confined to this place.

Experiments were recently made with the explosion of fixed torpedoes at a distance by means of Hertzian waves. The apparatus employed is the invention of Señor Balsera, a telegraph official. The results of the trials are declared to have been satisfactory. The inventor has asked for facilities to study the application of his system to the working of torpedoes.

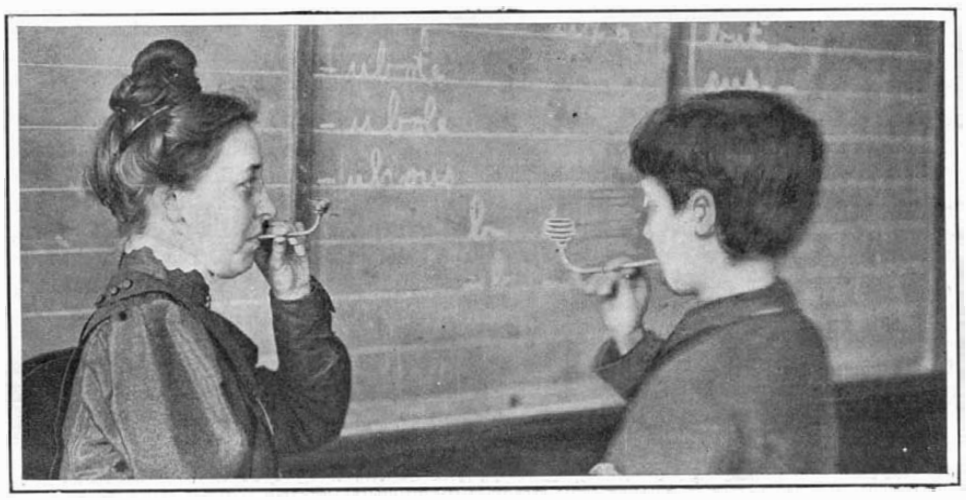
TEACHING DEAF-MUTES TO SPEAK.

It is a misnomer to refer to anyone as "deaf and dumb." Except in rare instances a child is mute, not on account of any malformation of the vocal organs, but because it is deaf and has never heard a spoken language. The loss of the sense of hearing should, therefore, not necessarily mean deprivation of the power of speech also. It is only within recent years that we have come to realize this fact, and in up-to-date institutions the old-fashioned finger alphabet is now unknown. Every child is taught to speak in the natural way by means of the vocal organs.

Odd as it may seem, the oral method of teaching deaf-mutes antedates the finger alphabet by over a century. In 1580 a Spanish monk, Pedro Ponce de Leon, taught congenital mutes to speak simply by instructing them first to write in characters the names of objects pointed out to them, and then to enunciate the sounds corresponding to the characters. But so little did the world value his discovery, that in less than forty years after his death he was forgotten, and Juan Pablo Bonet became the recognized founder of that method of instruction which Ponce had begun. This man, who was also a priest, published at Madrid in 1620 the first manual for teachers of the deaf, and which is in some respects still one of the best. The advantage of the articulate over the manual method of instruction was very slow to make itself felt. In 1850 several schools in the United States which had previously taught the sign method adopted a combination of the two. But not until 1867 was a school established which used the method of articulation only.

The articulate or oral system of teaching is based partially upon the imitative nature of the pupil. He has to rely much upon the observation of the movements of the teacher's vocal organs, and he endeavors to produce the same sounds by forming his lips and tongue in a similar fashion. A little instrument somewhat like a paper folder is sometimes used to bring the tongue into the proper position. It is of prime importance that the pupil perceive the difference between his own silent and the vocalized breath. This perception has been styled "the hearing of the deaf," and to produce it is the first aim of the instruction in labial reading. In the elementary classes the boys and girls are drilled into the A B C of articulation by being taken, one at a time, before a mirror and taught to imitate the movements of the teacher in making the sounds. Diagrams are also used to indicate the position of the palate or tongue in producing certain sounds. The whistling sound of *wh* is conveyed to the mind of the child by the aid of a pipe in the bowl of which is a little ball that is blown up and down as the sound is formed. In this way the children are taught to understand the value of various lip and palate formations in combination with the use of the lungs.

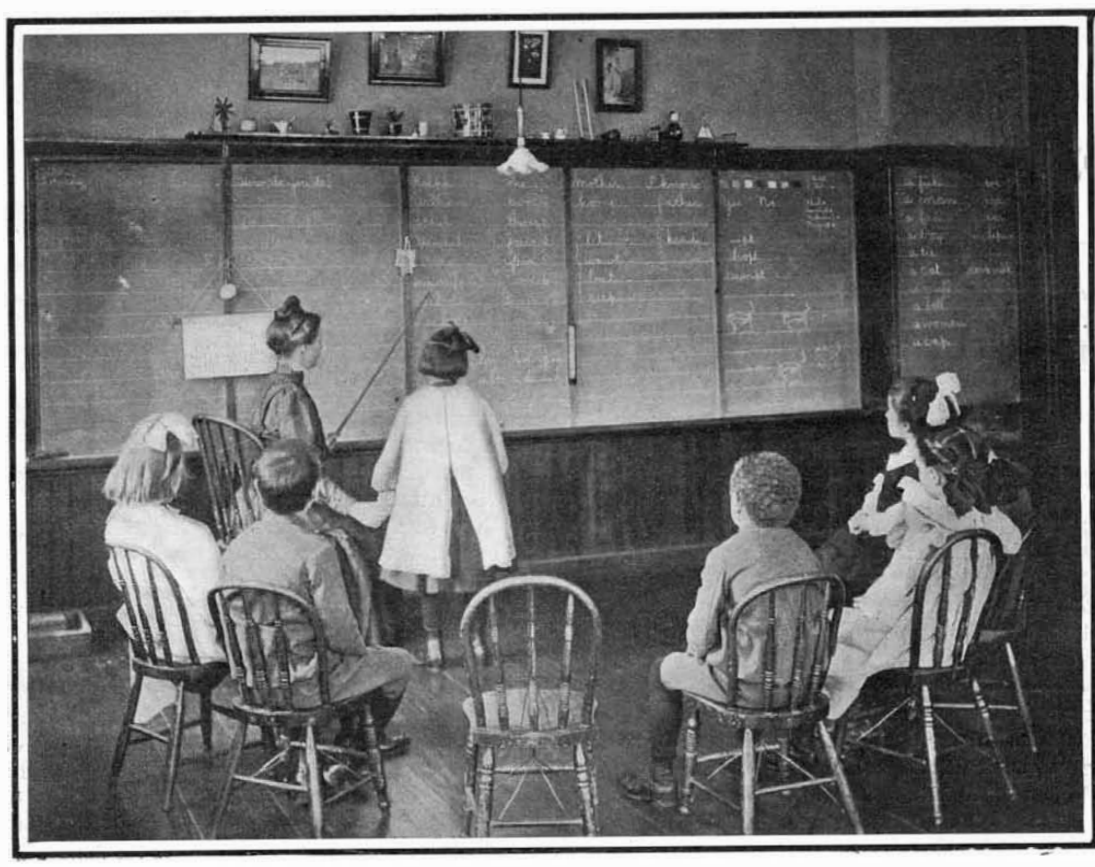
It is a strange experience to visit one of these schools, and see the teacher talking gravely to the classes of deaf-mutes and the children responding as quickly as though they could hear all that was said. The only indication of their affliction is found in the flat tone of their voices. Hearing nothing, the children



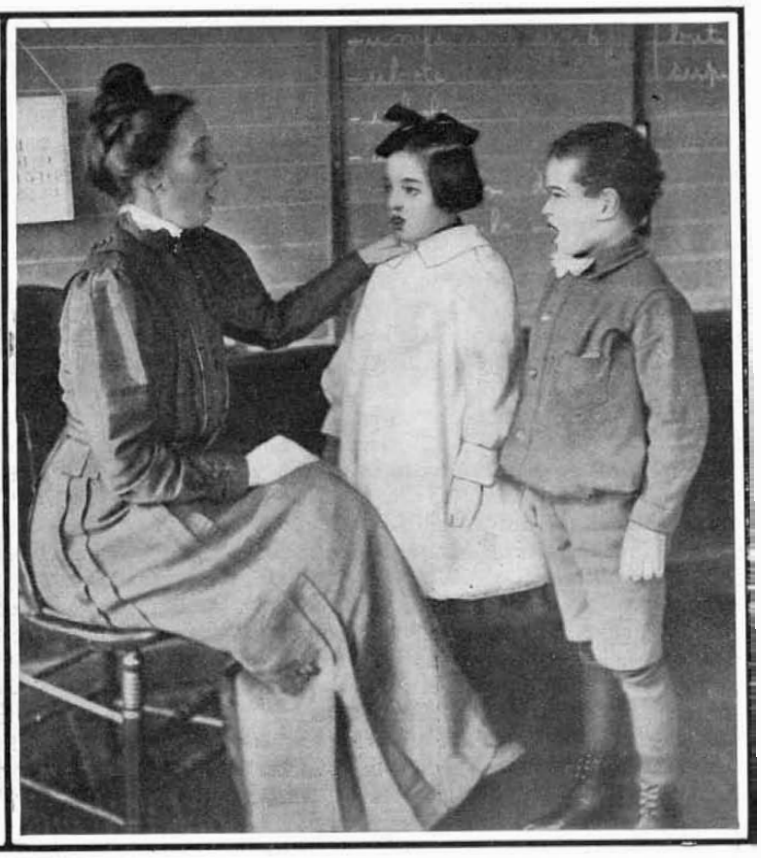
How the Sound of "wh" is Taught.

Demonstrating the Value of Vibratory Sounds.

Teaching a Pupil How to Count.



Teaching Pronunciation by Means of Phonetic Spelling.



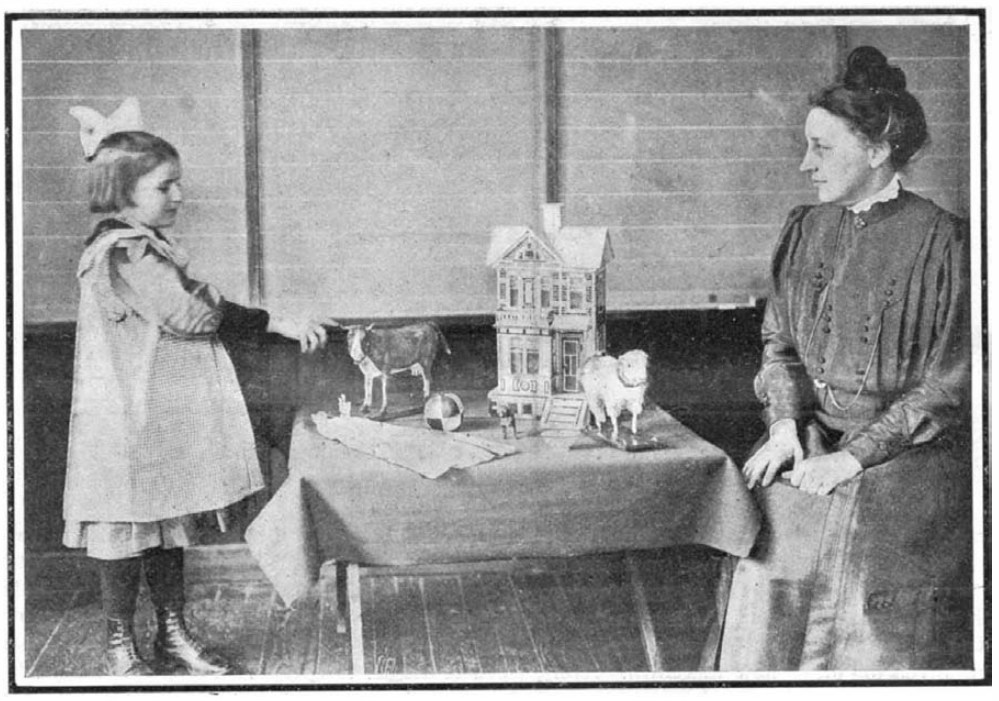
Correcting Wrong Breathing in Articulation.

TEACHING DEAF-MUTES TO SPEAK.

do not know the value of inflection, and hence speak with a dead tone which is quite pathetic. But there is nothing else to excite sympathy, for the children seem very happy. Every room has its corner filled with toys, which are used in explaining the names of objects. A child born deaf knows a cow by sight, but does not know that it is called a cow. Therefore, after the rudiments of articulation have been imparted to him, the next step is to teach the child to speak the names of the various objects about him. The teacher points to the toy cow, and makes the facial contortion necessary to articulate the word. The child imitates, and soon has the word correctly spoken. Then he is sent to the blackboard, and is taught to write the name of the animal. Thus he is able to connect the written and spoken language. Simple sentences are taught in a similar manner. A child is given a ball. He knows perhaps by this time how to pronounce the word *ball*, but he must be taught to use the word in a sentence. Another child is called up, and the first child is told to throw the ball into the hands of the second pupil. The teacher explains that the action is expressed by the word *throw*. Then the class is taught that the way to express that action is to say, "I threw the ball." Having learned that much, the thrower writes the sentence down on the blackboard, and the class repeats the line over and over again, a tendency to wrong accentuation being corrected in each one, as is necessary.

The development of language follows a clearly defined arrangement of grammatical principles. These principles, however, are not given the child as such, but serve as an aid to the teacher in the selection and arrangement of exercises in simple English—such natural English as will most readily lend itself to the needs of the child's daily life. Thus, language is at first interpreted to him by the use of objects, actions, and pictures. The four or five years of the primary course are devoted almost exclusively to the acquirement of language and numbers, with introductory lessons in geography. In the grammar school department arithmetic, geography, history, and natural sciences are taught as nearly as possible according to the best methods employed in an ordinary school. The formation of the speech habit and the reading habit is considered of paramount importance. As soon as the child has been taught spontaneously to express himself in spoken language, and to look for such expression in others, he is shown the delightful things that are to be found on the printed page.

In the modern schools for the deaf, the pupils are not only taught intelligible speech, but trades as well. The older girls are taught wood carving, drawing, cooking, and sewing; the boys are taught printing, cabinet making, drawing, tailoring, etc. The perfection of the oral method of instruction is strikingly noted by the fact that congenital mutes are, at the time of the completion of their course, able to speak so perfectly, that it is difficult to distinguish their voices from those of normal persons. After graduation many pupils enter high schools, and sometimes colleges. Thus the transformation is accomplished, and the once considered unteachable deaf-mute is changed into an intelligent and respected citizen, and the deaf as a class are being highly elevated in public estimation.



Explaining the Names of Familiar Objects by Means of Toys.

TEACHING DEAF-MUTES TO SPEAK.

Stamp Machines for the Postal Service.

Exhaustive tests are to be made of several types of automatic stamp-vending machines adapted to receive one-cent and five-cent pieces for the purchase of one-cent and five-cent stamps and postal cards. Two years ago experiments were made of such devices by the Post Office Department. The committee of experts reported that the machines were somewhat crude, and, while they accomplished the purposes for which they were invented, it was found that they could not be utilized to the advantage of the department.

While department stores, hotels, drug stores, news stands, etc., usually want the privilege of selling stamps, under the regulations of the department or upon their own responsibility, there is certainly no great amount of zeal or alacrity displayed by the persons vending the stamps. The purchaser at times feels that he should apologize for imposing upon the seller, because there is no direct profit in the sale, the privilege of selling stamps being desirable for the purpose of attracting other custom. Stamp vending machines in such places would be of great convenience to the public and no inconvenience to the proprietor of a department store, drug store or news stand, who might be glad to have the business done by machinery instead of being compelled to give personal attention to stamp sales.

The Dulac System of Concrete Pile Foundation.

One of the most interesting of the newer methods of establishing firm foundations for buildings in soft ground was invented by the French engineer Dulac, and was first used on a large scale in the construction of the buildings of the Paris Exposition of 1900, where much time and money were saved by the employment of this novel system.

The compression and stiffening of the ground which are effected by wooden piling are caused by the lateral displacement of earth as the piles are driven in. Dulac produces the same result by omitting the wooden pile and allowing a conical weight, raised by the pile driver, to fall directly on the earth in which it makes a vertical cylindrical hole which is deepened by each successive impact of the weight. After the desired depth has been reached the hole is filled with concrete which is rammed very tightly.

The concrete piling thus formed possesses the great advantage of being independent of the height of the ground water. Wooden piles, on the other hand, must be driven entirely below the lowest water level in order to prevent decay.

The Dulac apparatus consists of a pile driver of the usual construction, 30 or 40 feet high, and three weights of a horizontal diameter of about 30 inches. The weight used in the beginning of the operation is conical, sharply pointed, and weighs two tons. When the hole has attained a depth of a few yards, a weight of parabolic or sugar loaf form, also weighing two tons, is substituted and used until the desired depth is reached. The entrance of water can be prevented by throwing into the hole a quantity of clay which is plastered on the side of the hole by the falling weight. The diameter of the hole, before it is filled with concrete, is only a few inches greater than that of the weights. Holes nearly 40 feet deep have been made by this method.

The filling is commenced by throwing in a quantity of stones and ramming them down with the third weight, which is flat on the bottom and weighs one ton. The effect of the ramming is to broaden as well as solidify the successive layers and thus form a very firm base for the concrete filler. The concrete is then introduced in small portions, each of which is well rammed with both the flat-bottomed and the round-bottomed weights, and the process is continued until no more concrete can be forced into the hole. The compression and lateral distension effected by this method are so great that the volume of stones and concrete employed is about five times the cubic capacity of the original hole. Thus two desirable results are produced. In the first place a number of very strong concrete pillars are formed and, in the second, the soil between these pillars is compressed very forcibly so that it becomes capable of aiding materially in the support of the building.

Hardening an ordinary drill in sulphuric acid, states the English Mechanic, makes an edge that will cut tempered steel or facilitate cutting hard rock. The acid should be poured into a flat-bottomed vessel to a depth of about ⅛ inch. The point of the drill is heated to a dull cherry red, and dipped in the acid to that depth. This makes the point extremely hard, while the remainder remains soft. If the point breaks, re-harden, but with a little less acid in the vessel.

NATURE'S TOUCH-ME-NOTS.

BY PERCY COLLINS.

Nature is no haphazard experimenter. She is striving to promote the strength and fitness of her children, and by the process which we term "natural selection" is constantly weeding out the weaklings and evolving more perfect types. But Nature is not needlessly changeful. When she has discovered a good device she repeats it over and over again.

A striking example of this is seen in protective prickles. Nature seems to have proved that under certain conditions prickles form the best possible protective armament, and she has emphasized her discovery by an enormous number of instances, each brought through a different channel of development to the same conclusion. In the plant world, as everyone knows, prickles are common in the extreme; while, with the exception of birds, every important group of animals possesses its spiny representatives.

The common hedgehog is a well-known type of protective prickliness and its habit of rolling itself into a ball when alarmed must be familiar to all. This action is made possible by its thick layer of subcutaneous muscle, the *panniculum canosus*, which is more developed than in the case of any other animal. The young of the hedgehog, when born, have the prickles soft and white; but soon after exposure to the air they harden and become effective weapons.

The widely distributed porcupines, which get their name from the French *porc-épin*, or "spiny pig," form another interesting group of prickly mammals. The porcupine is a formidable antagonist, rattling its quills and running backward at the enemy, and will often succeed in driving off a jaguar intent upon its destruction. Mammalian prickles are really tightly packed masses of hair. This is well shown in the accompanying photograph of a series of specimens selected from a porcupine skin, showing the complete gradation from an ordinary hair to a perfect, sharp-pointed quill. (Fig. 8.)

Passing over the birds, whose marvelous powers of flight and diving seem to render any highly specialized protective devices unnecessary, we come to the reptiles. Of these, the armor plating of the tortoises and turtles, and the venomous means of the snakes are all-sufficient safeguards. But among the more vulnerable lizards we find numerous examples of protective prickliness. One of the most striking is the Australian moloch, termed the "thorny devil" by the early settlers. This remarkable creature is about eight inches in length, and its skin is studded all over with sharp, conical thorns. The moloch is very sluggish in its habits, feeding mainly upon ants, for which it lies in wait. One would imagine it to be exposed to continual attack from birds and rapacious animals; yet no animal is more perfectly immune. Its prickles are its safeguard. Equally well protected but perfectly harmless lizards are the so-called "horned toads" of California and Mexico. About twelve species of these quaint-looking creatures are known, all being alike in the possession of a formidable array of spines—several long ones at the back of the head, and a vast number of lesser prickles all over the back and limbs. (Fig. 12.)

Of fishes, a large number are protected from hostile attack by a covering of prickles. By far the most curious examples are the globe fishes, or "sea hedgehogs" of the Atlantic and Indo-Pacific oceans. The extreme length of the globe fish is something less than two feet. It has thick lips and goggle eyes which give it the appearance of a good-natured countryman. Courage it seems to lack, and one might suppose that such a simpleton would fall an easy prey to the first shark or dogfish it encountered. Yet the globe fish is able to take care of itself. It never, under any circumstances, attacks the enemy, yet is always ready to receive him in a suitable manner should he provoke hostilities. Let us suppose that a shoal of globe fishes is swimming tranquilly in the clear waters when it is suddenly surprised by a hungry shark. Of course the little fellows scuttle hither and thither in uncontrollable alarm. But the shark, poising himself upon his powerful tail, leisurely singles out one of the fleeing globe fishes, and sets out in pursuit. Now although the globe fish is a good swimmer, it is no match for the shark. The chase is in every way unequal and can have but one ending. Within a few minutes of its commencement the shark must overtake the globe fish. But the quarry is well aware of its danger. It makes a bee-line for the surface, and as soon as it gets there begins to take in great gulps of air. Then a strange thing happens. The fish that only a moment

before was thin and small begins to grow stouter and stouter until, like the frog in the fable, it seems in danger of bursting. It stops inflating itself, however, just in time to avert this catastrophe. But its skin has become as taut as a drum-head, and the whole of its body is covered with sharp, erect prickles. It has become a sea hedgehog, and the hungry shark which comes surging through the water dares not touch it, but turns tail in search of something more eatable. Of course the globe fish was covered with prickles all the time, but in periods of tranquillity these lie comfortably along its sides, just as do those of the hedgehogs. Unlike its land prototype, however, the sea hedgehog is unprovided with a special muscle for erecting its prickles, so when danger threatens, it has recourse to the mechanical method of inflating the whole body with air, or with water, if it cannot reach the surface quickly. In the sea, prickliness is a very common method of protection, especially among the smaller and more persecuted denizens. A number of large fishes, such as the plaice and cod tribes, pass much of their time searching for shell-fish, upon which they feed greedily. The plaice has particularly good teeth, which are strong and blunt. It goes nosing about in the mud of the sea-bottom, turning up cockles, razor-shells, and clams, the shells of which it cracks as easily as a schoolboy cracks a hazel nut, and feeds upon the mollusk within. But certain species of shell-fish furnished with prickly shells, seem to object to being cracked in this manner, for, when a hungry fish, rooting in the mud, comes in contact with one of these, it gets a nasty prick on the nose. Naturally, the finny searcher hastily abandons investigation in this particular direction, and the prickly mollusk is left uncracked and uneaten.

Similarly, many crabs, shrimps, and lobsters are protected by an array of spines and prickles. Crabs are much relished by certain fishes. As many as a dozen have been found in the stomach of one big cod. These, however, were a smooth-backed species, and a cod would never dare to swallow one of the thorn-backed crabs, of which numerous kinds are found in various quarters of the globe.

Before leaving the ocean, the sea-urchins, or echinoderms, must be mentioned, for, with the hedgehog, the globe fish, and the thorn-backed crab, they rank among the most prickly creatures known. They are enveloped in a wonderful shell, or test, composed of a great number of accurately fitting plates. The test is covered with needle-pointed spines, in some species these spines being eight or ten inches in length. Thus, the urchin dwells within a home the walls of which may be said to be guarded by scores of permanently fixed bayonets.

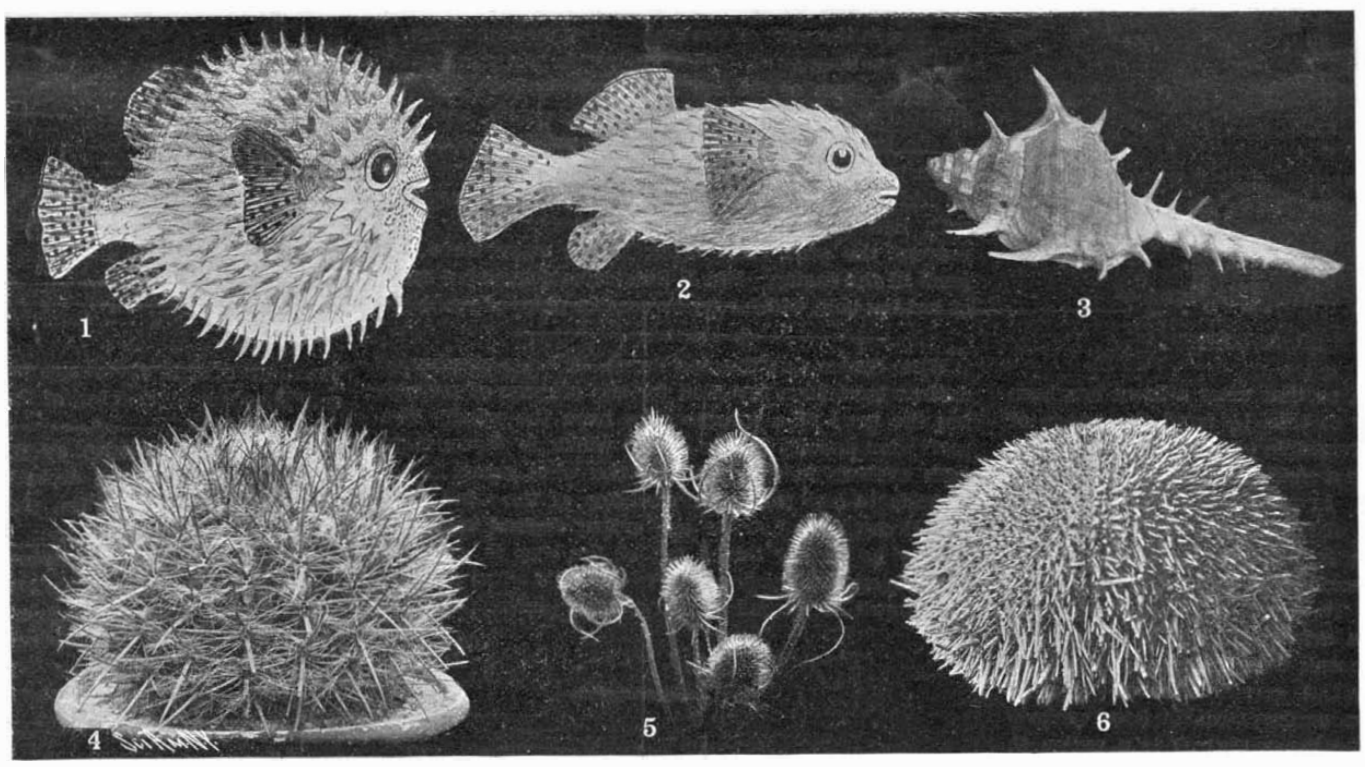
The world of insect life supplies us with myriad examples of protective prickliness. Many of the big insects, such as species from New Guinea, are simply beset with spines. Not a few caterpillars, too, are protected by closely set stiff hairs which correspond to the prickles of bigger animals, and are probably quite as effective for repelling small birds and lizards, the chief enemies of the caterpillar tribe. Some of the most remarkable insects yet discovered are certain Brazilian bugs, known as *Umbonia spinosa*. Each insect is an exact imitation of a single large thorn, such as is seen upon the stems of roses and other plants. This deceptive aspect is gained by a hard shield which completely covers the insect's body and wings, and under which its legs are drawn when it is at rest.

Turning from the animal to the vegetable kingdom, we still find prickliness a common means of protection. Sometimes we see sharp spines, which are to be regarded as modifications of branches, of leaves, or of parts of leaves. In other instances we find plants protected by true thorns, which are really massed vegetable fibers or hairs, and are therefore analogous to the quills of the mammalia. The main object of vegetable prickliness is, of course, to defeat the attacks of browsing animals.

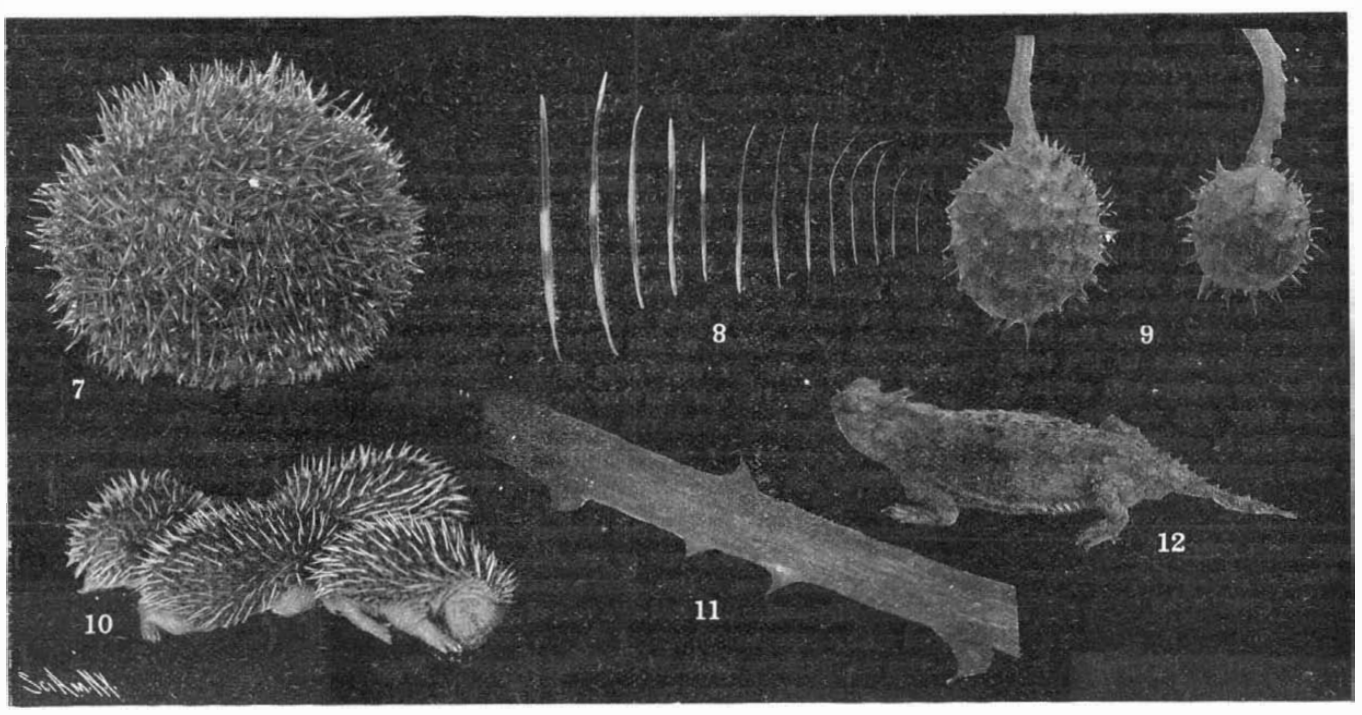
The cacti of Central America are, perhaps, the most interesting of all prickly plants. Here the sharp spines are to be regarded as the remains of departed leaves, although in the cacti the leaf functions are delegated to the swollen stalks, the spines being wholly protective.

We have all admired the beautiful flowers and have marveled at the quaint shapes of cacti, but to understand these plants it is necessary to call to mind the conditions under which they grow and flourish. Probably no plants have to contend with more adverse circumstances. Typical of the arid districts of Central America, cacti must keep green and fresh under a scorching sun through long periods of complete drought. This they manage to do by making themselves into what are really water-cisterns. A cactus is just a thick, juicy mass of green cells, storing sufficient water to enable it to flower and perpetuate its kind. But in a region where water is a luxury, its possession constitutes a real danger. The cacti have, as it were, "cornered" water, and have thus become objects of envy to thousands of thirsty creatures who would like to gnaw and suck and bite at their juicy stems. Such treatment would, of course, mean death to the cacti; and in order to protect themselves and their water from assault, they have acquired the formidable array of spines, and are thus able to flourish under conditions which would speedily annihilate almost all other kinds of vegetation.

Flowers are often protected by prickles, as in the case of the familiar thistle, or the teasel; while fruit capsules, such as those of the horse-chestnut and many exotic kinds, are also spiny. Did space permit, dozens of other instances of protective prickliness might be cited. The above examples, however, are sufficient to show how widely Nature has employed this particular means of defense.



1. Globe Fish Inflated for Protection. 2. Normal Form of Globe Fish. 3. Typical Spiny Shell. 4. Typical Cactus. 5. Teasel Heads. 6. Sea Urchin.



7. Rolled-up Hedgehog. 8. Porcupine Quills Developed from Ordinary Hair. 9. Prickly Fruit Capsules of Horse Chestnut. 10. Family of Baby Hedgehogs. 11. Thorn Bug; the First and Last Projections on Under Side of Branch Show the Bugs. 12. Horned Toad.

NATURE'S TOUCH-ME-NOTS.

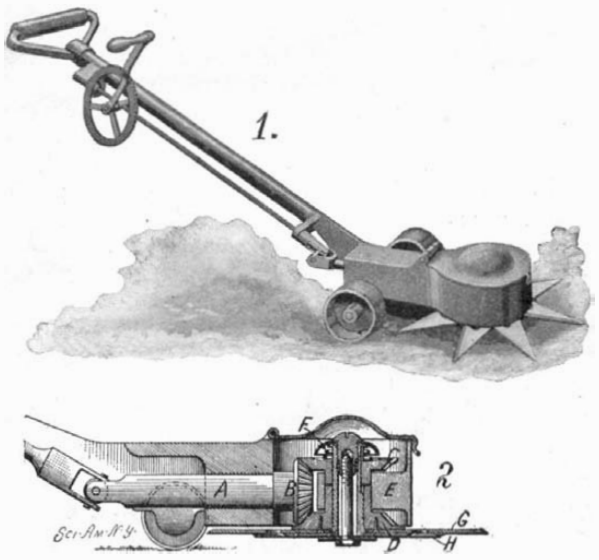
More Prizes for Safety Devices.

An international competition is announced for the successful design of two safety appliances for the purpose of protecting workpeople by the Associazione degli Industriali d'Italia per Prevenire gli Infortuni del Lavoro. One concerns the electrical industry, a gold medal and $1,520 being offered for a means of eliminating the danger of a contact, no matter what resistance, between the primary and secondary circuits of alternating-current transformers and their respective lines. It must be of simple design, of substantial construction, economical as regards cost and maintenance, and must be easily adaptable to existing installations. It must come promptly into action whenever the potential to earth of the low-pressure circuit attains double the normal value in the case of a three-phase, and two and a half times the normal value of a single-phase system, while at the same time it must prevent any excess in potential becoming permanent. The working of an installation fitted with this safety device must not be rendered more difficult, such as putting the transformer out of action in the event of atmospheric discharges or of such partial reduction of insulation of service lines to earth as may be acceptable in practice. Competing devices will be tested upon a high-pressure circuit of 3,600 volts. The second award is in connection with the evolution of a hand crane or winch, in which any danger of the handle rotating during the descent of a load without any appreciable reduction in efficiency or speed of descent may be prevented. The device or system must be of simple and substantial construction, and not liable to excessive wear. The prize offered is a gold medal and $200. The competitor must supply a complete apparatus capable of submission to practical test. Application to compete must be received at the address of the association, 61 Foro Bonaparte, Milan, not later than June 30, 1908, where further particulars may be obtained.

Patent Department

IMPROVED GRASS CUTTER.

One of the drawbacks to the ordinary lawn mower is that it cannot operate close to a fence and will not

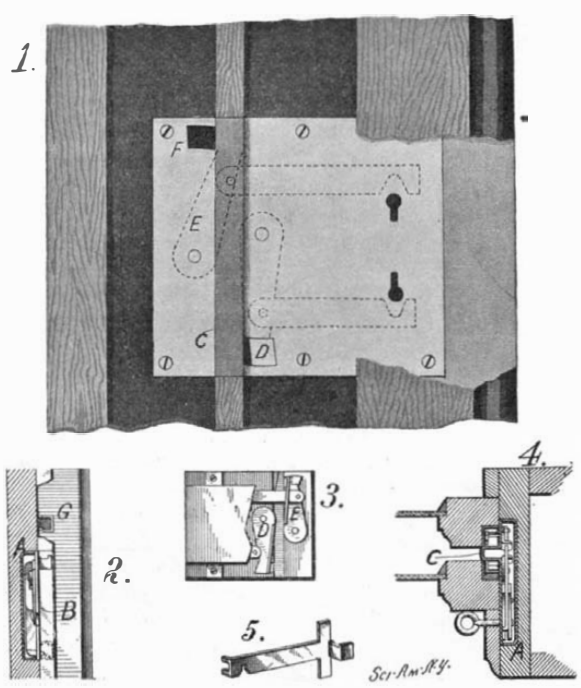


IMPROVED GRASS CUTTER.

reach into the corners, so that after a lawn has been mowed it is necessary to trim by hand the fringe of grass left at these inaccessible places. This trimming is commonly done with a sickle or with shears, and is a very tedious process. In order to expedite this work, Mr. Charles F. Crosby, of Burlington, Vt., has invented the grass cutter which we illustrate herewith. It will be observed that the mechanism is carried in a frame supported on wheels. The shaft *A* is connected by a universal joint with a drive-shaft which, in turn, is operated by a hand crank acting through a pair of bevel gears. The shaft *A* carries a bevel pinion *B* which, at opposite sides, meshes with the bevel gears *C* and *D*. Secured to the lower gear *D* is a cutter *G*. This cutter is of star shape, being formed with a series of projecting blades. The gears *C* and *D* are journaled in a bracket, *E*. A hollow shaft passes through both of these gears, and is splined to the upper gear *C*. Fitted to this shaft is a second cutter *H*, similar in form to the cutter *G*. A bolt which passes through the hollow shaft carries a washer at its lower end, which bears against this cutter. The opposite end of the bolt is threaded into a plug which, in turn, is threaded into the upper end of the hollow shaft. A cap carried by this plug engages a spring *F*, which is held in compression between the cap and the bevel gear *C*. It will be observed that the spring *F* serves to hold the two bevel gears into resilient engagement with the bevel pinion *B*, and also to hold the cutters *G* and *H* in resilient engagement with each other. Since the bevel pinion *B* is engaged on opposite sides by the bevel gears, it will be evident that the cutters will rotate in opposite directions, so that they will act like shears to cut the grass. In case a twig is caught between the cutters, the spring *F* will prevent breakage of the mechanism.

A NOVEL SASH LOCK.

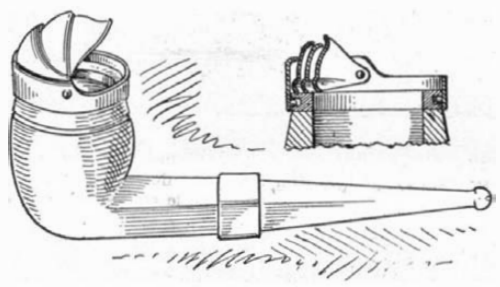
With a view to providing a simple lock which will enable either the upper or lower sash of a window



A NOVEL SASH LOCK.

with sliding sashes to be locked in an open or closed position, Mr. William Stephens, of Redding, Cal., has invented the device which we illustrate herewith. Fig. 1 of the engraving shows the jamb of a window casing with the lock set in place. This lock is fitted into a recess in the jamb, and consists of a case *A* in which the mechanism is contained, and a face plate *B* which is set flush with the jamb. The face plate is formed with an outwardly-disposed channel, *C*, which registers accurately with the parting bead. Within the case a pair of dogs *D* and *E* are provided. These dogs are pivoted near the center of the case, the dog *E* projecting upwardly, and the dog *D* downwardly. At the extremity of the dog *E* the face plate is provided with a circumferentially-disposed slot *F*, which extends through the side wall of the channel *C*, and a similar slot is provided in the lower portion of the case. Each dog is provided at its extremity with a toe which, when the sashes are not locked, lies within the channel *C*. The dogs are each connected to a lock mechanism in the case, and may be operated by separate keys to bring the toes in the path of the sashes. The toes are adapted to engage keepers *G*, which are set in recesses in the adjacent edges of the sashes. These keepers may be situated at any desired point in either sash, and one of the keepers should be placed at such a point that when engaged by the corresponding toe, the sash will be locked in closed position. The toes are provided with lips which pass laterally into the keeper, and prevent the sash from being forced away from the jamb of the casing. Fig. 5 illustrates a modified form of locking bolt, which may be used in place of the dogs.

WIND GUARD FOR TOBACCO PIPES.—A large number of devices have been invented for the purpose of protecting the bowl of a tobacco pipe from the wind. The particular novelty in the device which is shown herewith consists in the fact that the wind guard is adjustable to any particular direction of the wind, that it will cover the bowl to any extent desired, and that it may be readily folded out of the way in order to give the smoker ready access to the bowl when desired. The guard is formed of telescoping plates, which in

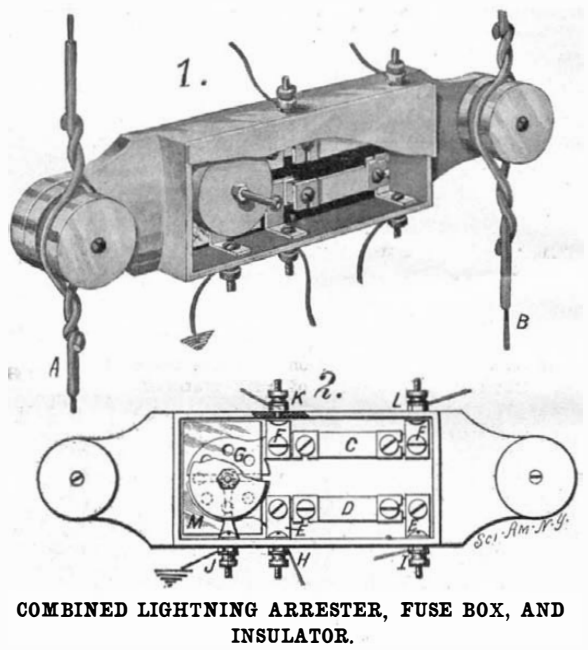


WIND GUARD FOR TOBACCO PIPES.

folded position lie approximately level with the top of the pipe bowl. They are hinged to a ring which is secured to the pipe by means of pins that project into an annular groove near the top of the bowl. This method of attachment permits the guard to be rotated to any desired position. When in use the telescoping plates are raised, and form a hood which rises over the mouth of the bowl, at the same time leaving sufficient opening for the admission of air. The extent to which the bowl is covered may be governed by the number of members which are raised.

COMBINED LIGHTNING ARRESTER, FUSE BOX, AND INSULATOR.

Pictured in the accompanying engraving is a device adapted for use on telegraph or telephone lines, which combines a fuse box, a lightning arrester, and an insulator. The device consists of a box of porcelain provided with extensions at opposite ends, each of which carries an insulator integrally formed thereon. These insulators provide means for attaching the line wires *A* and *B*. The device may be secured to a support by means of screws, which pass through openings in the insulators. Within the box are two pairs of fuse clips, in which the fuses *C* and *D* are made fast. The fuse *D* is connected by a pair of angle clips *E* with the binding posts *H* and *I*, while the fuse *C* is connected by similar clips *F* to the binding posts *K* and *L*. The current may pass from the binding post *K* through the fuse and binding post *L* to the instrument, and back again through the opposite binding post *I* and fuse *D* to the binding post *H*. A lightning arrester is provided in connection with the clips *E* and *F*. This consists of a pair of semi-cylindrical plates *G*, connected to these clips, and separated from each other by a slight gap. A sheet of mica, *M*, is placed over these plates, and supported on this sheet is a carbon block. The mica sheet is preferably perforated, so as to permit an abnormal discharge of electricity to pass from the plates *G* to the carbon block. The under side of this spark block is preferably provided with the usual cup or recess, to receive a fusible composition for the purpose of short-circuiting the arrester if the current is of too long duration. A spark clip connects the carbon block with the binding post *J*, to which a ground wire is attached, so that if the lightning should strike in such a way as to produce a current of great potential in the line, a spark will pass between the plates *G* and the block, and the current will be carried to the ground. By inclosing the fuses and lightning arrester within the porcelain box, there is no danger from fires in case the fuses burn out or a lightning bolt passes through the device. The



COMBINED LIGHTNING ARRESTER, FUSE BOX, AND INSULATOR.

inventors of this device are Messrs. Russel R. Burrin and Theodore F. Gaebler, of Rockville, Ind.

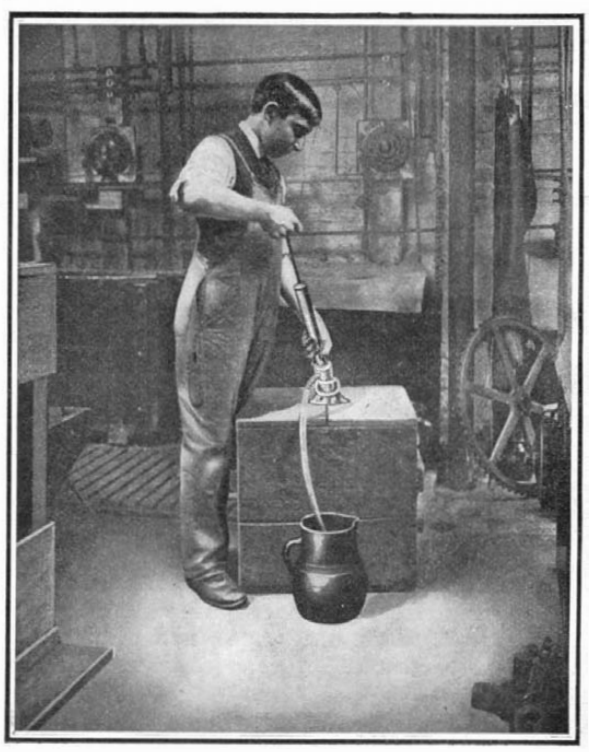
A NEW METHOD OF HANDLING ACIDS.

There has been an evolution in the methods of handling acids during the past few years, and very marked is the progress too. Acids, where these are used in any considerable quantities, are purchased in carboys, that is, large glass bottles inclosed in wooden boxes leaving only the neck exposed.

The old way of pouring out the acid required two men, one to tilt the carboy and the other to hold the receptacle. This primal scheme required not only an excess of labor, but was at the same time far from being safe.

An advance in methods was made when the carboy rocker was invented; for in this case, after the carboy had been lifted on the rocker, one man could handle the acid, and with little danger. The latest idea is to use an acid pump, a clever device designed and built by the Hanson & Van Winkle Company for the electroplating trade, but which speedily found its way into other arts and industries.

In using the acid pump, it is no longer necessary for two men to handle the carboy, nor is a man required to tilt the rocker. A boy suffices, for all that is needed is to carry the acid pitcher or receptacle to the carboy, when one end of the pump tube is placed in the acid, the rubber cork making an air-tight joint in the neck of the carboy, while the other end of the pump is carried to the pitcher. These simple preliminaries done, a steady flow of acid is obtained by pumping. After the flow is started, the device can be used as a siphon, where small quantities of acid only are required. Thus it is obvious that the acid pump conserves the energy of employees, is safe, simple, and effective, and insures with the minimum of labor the maximum of safety.



A NEW METHOD OF HANDLING ACIDS.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

SANITARY ATTACHMENT FOR TELEPHONE-TRANSMITTERS.—J. W. DOLSON, New York, N. Y. This attachment is arranged to enable the user of a telephone to speak against a clean piece of webbing extending across the mouth of the receiver, to insure the proper transmission of the sound to the diaphragm of the transmitter, and at the same time prevent the speaker from inhaling any unhealthy exhalations of a previous user of the telephone.

LOCK FOR ELECTRIC SWITCHES.—F. W. BRANDOW, Pittsfield, Mass. The invention relates to means for locking an automobile or vehicle of similar character in an inoperative condition, so as to prevent the vehicle from being removed or operated by any one not authorized to do so. It remains in such position until the switch is released by one familiar with the combination of the lock.

PARTY-LINE TELEPHONE SYSTEM.—G. E. TERHUNE, W. M. EIDSON, and W. B. HUSTON, Willow Hill, Ill. The invention provides an efficient lockout for preventing eavesdropping and interruption in conversation. Conceals the identity of such stations as may be busy, thereby preventing operators at other stations from ascertaining what persons are talking. Brings all business of the line under direct surveillance of operator at central station, thereby facilitating the ascertainment of tolls. Provides a selective call which disturbs no station except those desired; and, provides certain details toward simplicity, positiveness of action, and general efficiency of party line.

Of Interest to Farmers.

MILK-SAMPLER.—W. F. BÜCHER, Washington, D. C. In sampling milk from a can, it is important to secure equal portions throughout the vertical area being sampled, and also important to secure the sample without disturbing the cream or agitating the same so as to secure more than the proper proportion, and in doing this the inventor finds it important to arrange the tube so that it will cut down through the cream and thence down through the milk to the bottom thereof, and leave the lower end of the tube practically unobstructed until the bottom of the can is reached. The invention secures this result.

Of General Interest.

ATTACHMENT FOR SEWING MACHINES.—ANDREW G. ROSENTHAL, 872 Clinton Street, Milwaukee, Wis. The device comprises a pin cushion and thimble holder, formed on a plate which may be attached to a machine, by fitting it over the spool holder. A piece of emery paper on the plate provides means for sharpening the points of needles. In the complete illustrated description of this device, which appeared on page 396 of the SCIENTIFIC AMERICAN, Mr. Rosenthal's initials were incorrectly stated. The correct address is given above.

SUPPORTING STRUCTURE FOR BUILDING CULVERTS AND THE LIKE.—E. F. PARCAUT, Sutherland, Iowa. The object of this improvement is to provide a supporting structure for building culverts and the like of cement, concrete or other material, the structure being arranged to permit of quickly and conveniently building the culvert and to allow ready removal of the structure after the concrete or cement has set and hardened.

TELLURIAN.—C. B. MARTIN, Portland, Ore. The invention relates to educational appliances, and its object is to provide a new and improved tellurian arranged to demonstrate the various relations of the globe relative to the sun and moon, with a view to explain the different times, seasons, moon's phases, tides, etc.

FOREHEAD-BAND.—C. W. MABEY, Indianapolis, Ind. The invention has for its object to provide means adapted to relieve a person of headache and insomnia. The covering material may be saturated with chemicals of a character suitable to relieve headache or insomnia, and such chemicals are by means of such device adapted to be drawn from the covering material by the heat of the forehead of the wearer. It may be worn with a hat.

PENCIL-HOLDER AND POINT-PROTECTOR.—R. KLIPFEL, Larimore, N. D. In this instance the invention refers to certain improvements in devices for holding pencils and protecting the points thereof when not in use, and provided with a fastener by which the same may be instantly secured to the inside or outside of a pocket or to any other portion of the clothing.

MANIFOLDING-PAD.—S. W. GASS, Evart, Mich. This pad is to be used by store clerks in the recording of sales, where it is necessary to make duplicate slips of the name and price of each article sold, or other memoranda. For this purpose the inventor has constructed a book box adapted to contain a ribbon folded in a manner to pass freely from the box as it is withdrawn. The ribbon is made in two or more layers, passes over the top of the box to inclose carbon sheets therebetween in order that when the top layer is written upon, two copies more will result. Means provide for imprinting the succeeding layers.

ORNAMENTAL FENCE.—J. FORSTER, Los Angeles, Cal. The invention involves the use of a small amount of lumber, therefore making it economical of construction, and the parts may be all cut out by machinery and sold in a detached form to the person desiring to use the same, for the parts may be so easily assembled that a skilled workman is not necessary.

COMPOSITION FOR TREATING PAPER.—J. CZERNY, New York, N. Y. The invention is an improved composition for treating paper, especially in the form of card-board, rendering it hard, durable and resistant, particularly desirable in the manufacture of hair bottoms and many other articles. They will withstand wear and rough usage like wood.

MANUFACTURE OF ALLOYS.—G. E. BUTTENSHAW, Beechwood, Chorlton-cum-Hardy, Manchester, England. The object of this inventor is to produce articles in an alloy suitable for use in the construction of marine engines, pumps, sea valves, torpedo tubes, and the like, which are brought into contact with salt water and which shall not be liable to oxidize or set up galvanic action in the presence of iron and steel.

Household Utilities.

CLOTHES-LINE HANGER.—F. W. STEUER, Plainfield, N. J. The design in this invention is to provide a hanger to support a clothes line, and so constructed and arranged as to enable clothes to be placed on the line by a person within a room, and thereby avoid the dangers incident to leaning out of a window for that purpose.

COMB.—J. G. HIGGINS, Chattanooga, Tenn. The invention relates to combs, such, for instance, as are used for dressing the hair, the more particular object of the inventor being to provide certain constructional details whereby the comb is rendered composite in character, its several parts being thus rendered interchangeable.

FIRE-KINDLER.—W. H. HAGGERTY and W. J. DARDIS, New York, N. Y. The invention is an improved means for kindling fires, consisting of a suitable gas burner adapted to be suspended from the grate of a stove, open fire-place or the like, and heat the fuel therein in a few minutes to the point of ignition.

Machines and Mechanical Devices.

CASTING AND CONVEYING MACHINE.—W. MCVAY, Bellaire, Ohio. This casting and conveying machine is arranged to receive the molten metal from a blast-furnace in the casting-house, cast it into a convenient size and thereafter convey the casted iron or pigs, as they are usually termed, to the required point of discharge.

SAW-HANDLE.—W. B. MCCAIN, Clearlake, Wash. In the present patent the improvement has reference to saws manipulated by hand, and its object is the provision of a saw-handle which is simple and durable in construction, easily removed from the saw-blade, and without the aid of a wrench, screw-driver or other tool.

TYPE-WRITER.—C. GIBBS, New York, N. Y. In this case the invention relates to typewriters, and especially to that type of these machines which employs type bars. The object of the invention is the production of an improved arrangement which will facilitate the renewal of the type bars when they become worn.

COPY-HOLDER ATTACHMENT.—T. E. FORD, Philadelphia, Pa. The invention relates to typewriters, and concerns itself especially with a device adapted to hold copy and which is intended to be attached to the frame of typewriters of the form used especially for writing upon open books, or tabulating sheets. These typewriters are known commercially as book typewriters.

WAVE-POWER MOTOR.—T. DANFORD, Granby, Col. Among other objects of this invention is to provide a machine in which suitable provision is made for the unequal levels of the water caused by the rising and falling of the tide, combined with a power transforming mechanism to reduce the quick, impulsive and variable movement of the parts initially driven by the motor, to a constant, rotary motion.

COMBINED MEASURING, WINDING, AND WEIGHING MACHINE.—C. W. COTTRELL, Washougal, Wash. In this patent the invention is an improved combined machine for measuring, winding, and weighing rope, wire cable, and like material, to be used by storekeepers in the sale of such goods, thereby lessening the labor entailed when these operations are performed in the usual manner.

Prime Movers and Their Accessories.

ROTARY ENGINE.—T. S. BARWIS, Vancouver, British Columbia, Canada. The object in this invention is to provide for the quick reversal of the engine or turbine when desired. The improvement consists of a cylindrical casing in which is journaled a revoluble drum, carrying blades subject to pressure of the working fluid and having a shiftable member or part, automatically operated to change the direction of rotation.

REVERSING-GEAR FOR GASOLENE-ENGINES.—H. E. ZASTROW and J. H. KOEPP, Portage, Wis. The invention consists in means for reversing without having to gain access to the interior of the engine, and it comprehends as its most distinctive feature a construction of slip clutch between the timing wheel and its shaft so that the wheel may turn a given distance on the shaft independently of the shaft and then take up against and turn rigidly with it, in connection with an adjustable circuit controller.

CLUTCH.—B. F. REICHENBERGER, Township 4, Brown Co., Kan. In this patent the invention has reference to a clutch for connecting rotary elements. It is useful in connection with various branches of mechanical arts, but is especially intended for application to the crank shaft and fly wheel of traction engines.

APPARATUS FOR GENERATING AND STORING PRODUCTS OF COMBUSTION UNDER PRESSURE.—T. H. COLE, 54 Margate road, Southsea, Hants, England. Mr. Cole's invention relates to the generation of power by the combustion of a gas or vapor within a confined space, and it has for its object to provide means whereby the greatest practicable elasticity, or flexibility may be obtained in the application of the power generated in an internal combustion motor. This primary motor is adapted to work on a four-phase cycle.

STEAM-TURBINE.—E. HARVEY, New York, N. Y. The invention is an improvement in steam turbines especially directed to compound condensing marine engines capable of being reversed. The turbine engine is capable of having a high, an intermediate, and a low pressure chamber, each of which is provided with a novel form of piston.

REVERSING STEAM-TURBINE.—W. C. GARDINER, 17 St. Clement Street, Aberdeen, Scotland. In the present patent the invention has reference to multiple expansion reversible steam turbines wherein the rotary distribution valves are employed for the purpose of varying the expansion of the steam and determining the direction of the revolution of the rotor.

Pertaining to Recreation.

PUZZLE.—W. WERNER, New York, N. Y.—The puzzle is preferably in the form of a deck of playing cards and consists of a number of cards, numbered consecutively and arranged in sets or suits, each set being formed by a number of cards, and each card being provided with a colored design, preferably a geometrical figure, the designs and their colors in a set being different, and the colors of the same designs in the several sets being different.

TOY.—A. UEBERLE, New York, N. Y. This invention has reference to toys designed for children's use, and consists primarily of a doll and means connected therewith adapted to enable the doll to be placed in different positions and made capable of various movements to suit the fancy of the user.

Pertaining to Vehicles.

LOG-CART.—J. A. PERRY, Burgaw, N. C. The invention is an improvement in that class of log carts or carriers in which the log is suspended from an axle by means of chains. The main feature of the improvement is the pivotal connection between the hounds and tongue, or any form of rigid arm suitably connected with the axle so as to serve practically as a rocking lever.

EYE-PROTECTOR.—E. VERDEAU, New York, N. Y. The more particular object in this invention is to provide a form of mask suitable for use by chauffeurs and drivers of vehicles, the construction being such as to prevent the collection of snow, sleet, frost, or water from gathering upon certain parts of the mask so as to obstruct the vision.

WHIFFLETREE.—S. A. HAZELTON, Pavilion, N. Y. Among other objects of this invention the inventor provides a whiffletree which can be automatically operated to detach and attach the traces of the harness quickly and with little labor, and to inclose all of the operating parts in order that they may be obscured from view and protected from the weather.

LAMINATED TIRE.—J. W. CARHART, Austin, Texas. The invention relates to tires, such, for instance, as are used upon automobiles and other road vehicles, the more particular object being to produce a tire built up of laminæ so as to possess great strength and resilliency, and to be easily constructed of comparatively cheap materials as well as to be easily repaired, or to be replaced either in whole or in part.

JOINTED-SPINDLE AXLE.—M. BIDEAU, 16 Cité d'Antin, Paris, France. The invention relates to axles having jointed spindles, chiefly designed to receive the steering wheels in a motor-car, and the object is to so mount or fit the axle that it will allow of a ball bearing or washer being arranged between the body part of the axle and the spindle around the stud of the vertical joint of these parts to avoid any injurious movement out of the perpendicular with respect to the said stud.

AXLE-NUT.—T. MILLIGAN, Fortuna, Cal. In this instance the improvement pertains to axle nuts, and has for its object the provision of a compensating means adapted to take up the lost motion occasioned by the wearing of the end of an axle box, and thereby holds the box against longitudinal motion on the axle.

WHEEL.—I. W. GILES, New Bedford, and C. W. TOBEY, Fairhaven, Mass. This improvement is in the tire construction of wheels. An elastic tire is employed which may be of solid rubber. The construction of the tire fastening devices with the lugs and links connecting the hooks provide means that co-operate with independent rings of the supporting tire, the flexibility of the stud connection co-operating with the yielding of the rings of such supporting tire in securing flexibility of the wheel. Means operate for extending the supporting plates toward securing the desired flexibility of the wheel.

VEHICLE-TIRE.—G. E. HUGULEY, Atlanta, Ga. One purpose of the present invention is to provide a supplemental tread section for the outer tubes of pneumatic tires, or any rubber tire used upon wheels of automobiles or similar heavy vehicles, which supplemental tread section can be quickly, conveniently, and firmly applied.

Design.

DESIGN FOR RIBBON.—E. M. CORBETT, Paterson, N. J. This ornamental design for a ribbon comprises a band of fabric with vertical double lines and single cross lines which make a pattern of very small squares. Bow knots run in an oblique direction and at regular intervals down the ribbon.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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Minerals sent for examination should be distinctly marked or labeled.

(10542) V. B. asks: I would like to obtain some rule for the repulsion of permanent magnets: For example: if two magnets have an attraction of two pounds pull, what would be the repulsion between them if one of the magnets be turned end for end? Also, what repulsion would it be possible to get between two magnets, one of any weight and either electro or permanent, and the other to weigh two ounces and be permanent? A. The repulsion between two similar magnet poles is the same as the attraction between two opposite poles in the same position, whether they be permanent or electro-magnets. The repulsion dies out very rapidly as the poles move away from each other, and the attraction increases very rapidly as the poles approach each other. This is due to the low permeability of the air. The force varies inversely as the square of the distance between the poles. We have never tried the experiment to find the maximum force which could be obtained in any given case, but there is no answer to your indefinite question as to the force between a magnet of any weight and form and a permanent magnet weighing two ounces.

(10543) C. E. R. asks: 1. Will an alternating current meter register if the current is coming in at one of its entrance wires and leaving by one of its exit wires? A. We should not expect a meter to register unless all its binding posts had wires attached to them. You should, however, refer the matter to the company controlling the meter, since there are many kinds of meters of widely different construction. No general answer can be given. 2. What liquid and plates are used in a cell which chokes off one of the alternations of an alternating current, giving an intermittent direct current? A. The plates in an electrolytic rectifier are generally iron and aluminium, the electrolyte some potash salt. 3. On a ground return ¼ mile telephone line when one end is grounded and a receiver connected at the other, sounds are heard which are separated into dots and dashes, which sound exactly like the sparks of an induction coil. The steady hum of alternating current lighting circuits is also heard, but has a quite different sound. At times there are apparently dots and dashes being sent by several different coils at the same time, as their tones are different, some high, some low, some loud, some weak. There is no coherer or other detector in the circuit. Under these conditions is it possible to hear wireless unattuned messages? A. The grounded telephone line upon which you hear sounds is able to take up any sort of sound in the neighborhood. The telegraph signals you hear are probably those of

some neighboring telegraph line. The alternating current hum is from some line, it may be farther off. It is doubtful if you hear wireless telegraph signals, although it is possible that you do so. The remedy is to put in a metallic return on your telephone line. All these sounds will then cease. 4. Does the covering of the high potential electric lighting wires completely protect them, or is it still dangerous to touch the insulation? A. The insulation of a wire is supposed to protect any one from the current which it is carrying. If the covering is in good condition, it will be sufficient to insulate the current.

(10544) I. C. D. asks: I should like to ask upon what do mosquitoes feed other than human blood? What attracts them to a residence? Are vaults favorable breeding places? A. Mosquitoes feed on blood in the imago state. They bite other animals besides man, as you may see by watching them. They fly about and into houses in search of food. Stagnant water is their usual breeding ground. They like cisterns of rain water near houses. They emerge from the water in the afternoon, dry themselves, and are ready to fly at dusk. Any receptacle with water standing in it will be used for bringing up a family of mosquitoes, even old cans for tomatoes and vegetables. All such things should be carefully picked up and put bottom upward where they will not get water into them, if one would be rid of the pest and danger of mosquitoes.

(10545) J. S. J. asks: I wish to ask you a probably very simple question in your estimation, thus: Will an electric light meter register the same at the end of a month when 4 C. P. lamps are used as it would had 16 or 32 C. P. lights been used, voltage being the same in both cases? A. An electric meter usually registers watts, or the product of volts and amperes. A 4 C. P. lamp cannot take as many watts as a 16 C. P. lamp, and a 16 C. P. lamp will use only about half as many watts as a 32 C. P. lamp. The meter only registers the watts which are used. Lamps of 16 and 32 C. P. use 3 to 4 watts per candle when the lamp is in good condition. This quantity the meter should show.

(10546) J. C. R. asks: Will you explain the following experiment? I set the front wheel of a bicycle in motion and then I placed one end of the axle on my first finger. The result: While it revolves on its axle it also tends to revolve in an orbit around me. If you revolve it with the axle vertical, it tends to revolve in an orbit as before. A. The bicycle wheel in your experiments is a form of gyroscope and revolves as this instrument does. You will find it explained in Hopkins' "Experimental Science," where many forms of the gyroscope are illustrated.

(10547) L. C. asks: 1. I have made a siderostat. The rather substantial mirror mount is attached to the shaft of a bicycle forewheel bearing. From a 4-inch pulley on this shaft a belt runs to an inch pulley on the hour sleeve of an ordinary clock. Could you suggest any wrinkles for reasonably accurate adjustment? It is intended for projection work in latitude N. = 45 deg. 30 min. 24 sec. A. You will require that the mirror of your siderostat should rotate in altitude 47 deg., the amount by which the altitude of the sun varies in a year. In December the sun will at noon be 21 deg. above your southern horizon, and in June it will be 68 deg. above your southern horizon. A gear and a rack will be as simple a method of adjusting the mirror as any. The rod can enter the room through an opening and give you the ability of adjusting the beam at any time. 2. What is the longitude of the places in the different time zones whose local mean time is taken for the standard time for the whole zone? A. The longitudes which are taken as the standards for the time zones in the Western Hemisphere are: 60 deg. west, colonial time; 75 deg. west, eastern time; 90 deg. west, central time; 105 deg. west, mountain time; 120 deg. west, Pacific time. This system is independent of the location of places or cities. Eastern time happens to differ less than four minutes from local time at New York. Chicago is about ten minutes from the 90th meridian. The central lines of the time sections are the meridians of even hours from Greenwich.

(10548) R. L. H. asks: Kindly publish in the columns of your paper whether or not the magnetism in a watch can be detected with an ordinary compass. If not, what is the proper method? A. To determine whether a watch is magnetized, place it on the face of a compass in a flat position, and turn it slowly around. If it is magnetized, it will in some positions repel the magnetic needle, turning it away from its north and south position, and in others it will attract the needle. If it is not magnetized, it will attract the needle feebly in some positions, and more strongly when the main spring is near the needle. There will be no repulsion in any position.

(10549) W. M. F. says: Please inform me what would take away the echo from a hall which is on the third floor of a building. I do not want to use a sounding-board, as it is too expensive. I have inclosed a small plan of the hall. A. We do not think a sounding-board would assist the acoustics of your hall. It is just as bad as a hall can be; a square box with a curved ceiling (if we read your drawing aright) and with a hard wall. An abundance of soft hangings along the side walls, such as heavy curtains upon poles, as if there were windows in the wall, is advisable. Such echoing halls are often much improved by stringing fine wires across them, several feet above the heads of people; in your hall this might be done nine feet above the floor. Another decoration can be added which would deaden the noises, by putting up an abundance of bunting or cheesecloth from the center of the ceiling to the sides and corners as when the hall is dressed for some patriotic occasion. A gallery with rising rows of seats would assist much in breaking up waves of sound. You cannot hope to destroy the echoes except by such means as these. The idea is to replace the hard surfaces of the wall by soft and yielding materials, and to break up the rectangular character of the room, and particularly the vaulted ceiling, as much as possible.

(10550) C. N. writes: It has been asserted recently in a photo-magazine that the beam of light entering the lens of a camera during the exposure of a plate for 1-1000 of a second is 185 miles long. (1-1000 part of the velocity of light taken at 185,000 miles per second.) It is stated in support of the allegation that the light entering the lens during an exposure has "its origin in the sun, and the beam, or rather the multiplicity of rays, hit the object, are reflected therefrom, and ultimately reach the plate." Without contesting the explanation of the action of light, is the explanation a sound argument that the length of the beam is 185 miles? If not, is the length merely the distance of the object—say 50 feet from the camera? A. The statement as quoted from the journal is quite correct. As much light strikes the plates as light travels in the time of exposure. A second exposure, and 185,000 miles of light waves strike the plate. The light does not stand still between a plate and an object 50 feet away. It comes from the object all the time. It moves as fast from the object to the camera as it does anywhere in the air. And the action of the light is cumulative upon the plate; 185 miles of waves beat against the plate and affect it 1-1000 as much as 185,000 miles of waves would do.

(10551) H. L. F. says: Can a locomotive make better time on a high mountain than on the sea level, provided that the grade is the same in each case? It appears as though if air is rarer there would be less back pressure, and for that reason the steam would act more powerfully on the piston rod. A. Whatever advantage in steam pressure a locomotive would derive at a high altitude from the reduced pressure of the air would be met by the reduction of the quantity of oxygen in the air. If back pressure is reduced by the former cause, the amount of air needed to consume a certain weight of coal would be increased by the latter. We also think that the steaming qualities would be impaired on the mountain. We have no data of actual runs at hand, but should not expect any great difference between sea level and the altitudes attained by ordinary roads.

(10552) M. F. S. says: Will you please give, in an early number of the SCIENTIFIC AMERICAN, a receipt for polishing horns for hat racks, etc.? A. First scrape with glass to take off any roughness, then grind some pumice stone to powder, and with a piece of cloth wetted and dipped in the powder, rub them until a smooth face is obtained. Next polish with rottenstone and linseed oil, and finish with dry flour and a piece of clean linen rag. The more rubbing with the stone and oil, the better the polish.

(10553) C. R. V. says: If a water pump, plunger type, should be made from a tube having a ½- or ⅝-inch bore, and plunger fitting snugly in same, check valve each side, etc., plunger moving or having a stroke of 4 inches, what would be the limit of revolutions per minute if fastened to a wheel and crank, that it would work satisfactorily? Would it be necessary to decrease the revolutions per minute in ratio to increasing the stroke to gain same results as a smaller or shorter stroke? What is the fixed rule for this? A. The most practical speed for the plunger of all pumps is about 100 linear feet per minute. This speed is irrespective of the size of the plunger and the length of the stroke. If this speed is much exceeded, the valves do not seat properly and the pump does not work smoothly. If the stroke is decreased, the number of revolutions per minute may be increased in the same ratio to keep the piston speed the same.

(10554) H. W. H. asks: Is there more expansion of a charge of air and gas when burnt or exploded in a closed chamber than in a jet in the open? What is the cause of a pipe snapping when steam is first turned in it? A. The result of the burning of a certain charge of gas and air is not dependent upon its being in a closed or open space. The same amount of heat and gases should be produced, whether the explosion takes place in the open or in a closed chamber. In the open air the resulting power cannot be used, and is soon dissipated into the space around. The noise produced when steam is turned into a cold pipe is due to the partial vacuum produced by the condensation of the steam. It is called a water hammer.

NEW BOOKS, ETC.

NAVIGATING THE AIR. By members of the Aero Club of America. New York: Doubleday, Page & Co., 1907. 8vo.; 259 pp.; numerous half-tone illustrations. Price, $1.65 by mail.

This book is intended to give a scientific statement of the progress of aeronautical science up to the present time. Opening with a preface on the "Aero Club of America" by Mr. C. F. Bishop, its president, and an introductory chapter by Carl Dienstbach telling in brief what has been done up to the present in all branches of the art, the book consists of twenty-three chapters proper by leading American aeronauts and experimenters.

A number of these deal with balloons and ballooning in all of its phases, and include articles by A. Lawrence Rotch, William J. Hammer, Augustus Post, Leo Stevens, and J. C. McCoy. Others, such as "The Use of Kites and Balloons in the United States Weather Bureau," by Oliver Fassig, Ph.D., and "The Direction and Velocity of Air Currents," by Charles Fiesse, will be found interesting by all aeronauts and students of meteorology. "The Coming Dirigible Airship" is a very interesting chapter furnished by Capt. Homer W. Hedge.

Turning now to the heavier-than-air craft, the reader will find a brief chapter by Octave Chanute describing "The Wright Brothers' Motor Flyer," and another short essay by the brothers themselves on "The Relations, Weight, Speed, and Power of Flyers." Israel Ludlow describes the experimental flights made with his man-carrying aeroplane, which was towed by a tugboat and by an automobile, and through an attempt at riding in which Mr. Ludlow received a serious injury. Dr. Alexander Graham Bell has furnished an extract from his address on "Aerial Locomotion," which was delivered before the Washington Academy of Sciences last December. This extract is entitled "A Few Notes of Progress in the Construction of an Aerodrome," and it deals with some of his experiments with tetrahedral kites. "How to Fly as a Bird" is the title of a very interesting chapter dealing with an aeroplane constructed along the lines of a Venetian blind. Phillips, in England, found that this arrangement of long, narrow, superposed planes was the most efficient, and Mr. Holland has designed a very interesting machine along these lines. Mr. William A. Eddy contributes an article entitled "Experiments with Kite-Sustained Aeroplanes," and Mr. A. M. Herring describes a simple propeller-testing device with which he has made several hundred tests of various propellers. "Rubber Motors and Flying Machine Models" is the title of a very interesting article by Mr. William R. Kimball. Mr. Kimball has experimented with numerous helicopter models, some of which are illustrated. Prof. William H. Pickering, of Harvard University, also discusses this type of flyer. Prof. David Todd, Ph.D., contributes an article on "Aerial High Speed," in which he discusses the problem of the hydroplane, or gliding boat, and the much more difficult one of the aeroplane. Charles M. Manly, who was the late Prof. Langley's assistant in his experiments with an aeroplane, makes some "Critical Remarks on Progress," and Dr. A. F. Zahn discusses Dr. Alexander Graham Bell's paper, and also furnishes an article on "The Law of Atmospheric Resistance of Wires and Rods." The book is illustrated with some sixty half-tone plates, a considerable number of which have already appeared in the columns of the SCIENTIFIC AMERICAN, while most of the other photographs are from the collection of William J. Hammer. This book will be welcomed by all aeronauts and others interested in the new science, as it gives a very good idea of the state of this science at the present time.

LA TÉLÉGRAPHIE SANS FIL ET LA TELEMÉCANIQUE. A la Partée de Tout le Monde. Par E. Monier. Preface by D. E. Branly. Paris: H. Dunod et E. Pinat. Second edition, revised and enlarged. Price, $1.

An excellent idea of this volume can be gained from the preface to it, written by Dr. Branly, the inventor of the coherer, the translation of a portion of which is given below:

"Although the explanation of the effects obtained does not present great difficulty, the authors who have endeavored to popularize the new methods have thought it necessary to leave them in a sort of half obscurity which imposes on the good nature of the reader, and probably increases his respect for science.

"In dealing with the elementary principles, M. Monier has succeeded in giving a sufficiently precise and complete idea of wireless telegraphy, and he should be congratulated on not having given way to the temptation of writing a heavy, abstract scientific work. Those who may have the good fortune to read his work will owe him great gratitude, for they will know those things that they should know about the subject without having had much trouble in learning them."

THE CONCENTRATION OF WEALTH. By Henry Laurens Call. Boston: The Chandler Publishing Company. 12mo.; cloth; 48 pages.

Mr. Call's paper, read before the American Association for the Advancement of Science, at Columbia College, New York, December 27, 1906, presents in very clear form, backed up by statistics, the fact that the working classes are obliged to struggle more strenuously for existence than formerly, and that the small dealer and the small producer have been entirely crushed out of existence by the trusts. This state of affairs is generally admitted as being a very grave menace to our national development. A remedy must be sought; yet we think Mr. Call's plan of relief too radical and too visionary.

LEHRBUCH DER GERICHTLICHEN CHEMIE IN ZWEI BÄNDEN. ZWEITE GÄNZLICH UMGEARBEITETE AUFLAGE. Bearbeitet von Dr. George Baumert, Dr. M. Dennstedt, und Dr. F. Voigtländer. Zweiter Band. Der Nachweis vom Schriftfälschungen, Blut, Sperma, u. s. w., unter besonderer Berücksichtigung der Photographie. Braunschweig: Druck und verlag von Friedrich Vieweg und Sohn. 8vo.; paper cover; 248 pages, illustrated.

Dealing with such problems only as admit of scientific and tangible solution, this work is of rare service to the criminologist. Various methods of tampering with handwriting are discussed and their detection explained, as are also described the microscopical examination and identification of the many substances that are apt to figure in criminal cases.

TYPES AND BREEDS OF FARM ANIMALS. By Charles S. Plumb. Boston and New York: Ginn & Co. 8vo.; cloth; 563 pages, illustrated. Price, $2.20 postpaid.

Not since 1888 has a volume devoted to the breeds of horses, cattle, sheep, and swine been published in America. The most recent work devoted to the breeds entirely omitted a consideration of the horse. This book differs somewhat from others that have preceded it, in that a number of breeds have received recognition for the first time, these being the ass, the mule, the angora and milch goats, all of which are important in certain localities. The more important breeds have received more minute mention than those that have had less influence in developing the given stock. The photographs of typical individuals, with which the text is freely illustrated, give a better idea of the desirable qualities of the different varieties than could be gathered from pages of descriptive matter.

MODERN METHODS OF TESTING MILK AND MILK PRODUCTS. By Lucius L. Van Slyke. New York: Orange Judd Company. 12mo.; cloth; illustrated; 214 pages. Price 75 cents.

Now that the full danger of impure milk, due either to unsanitary conditions in its production, or to adulteration, is realized, a knowledge of how to test milk is of value to everyone. The tests described by Mr. Van Slyke are chosen from those that do not require complicated apparatus or an undue degree of technical skill, and yet are reliable. The volume is written simply, so that by paying strict attention to details, the experimenter can acquire the necessary expertness with very little practice.

THE WALSCHAERT LOCOMOTIVE VALVE GEAR. By W. W. Wood. New York: The Norman W. Henley Publishing Company. 12mo.; cloth; 193 pages; illustrated. Price, $1.50.

Now that the enormous size of our modern locomotives makes the weight of the "Stephenson link motion" a factor that must be taken into consideration, engine builders are commencing to install a method of valve actuation that has been in satisfactory use in Europe for over half a century, namely, the Walschaert valve gear. The work by Mr. Wood treats of this gear from four different standpoints in as many divisions of his volume. The First Division is a simple analysis of the gear; the Second Division deals with designing and erecting the gear, and is suited for the master mechanic; the Third Division tells of the advantages of the system, and the Fourth Division is devoted to "Questions and Answers on the Walschaert Valve Gear." Numerous drawings accompany the text as illustrations to the various points emphasized; one set especially, showing the valve gear in nine different positions, makes the book a necessity among railroad shop men.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending May 28, 1907.

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

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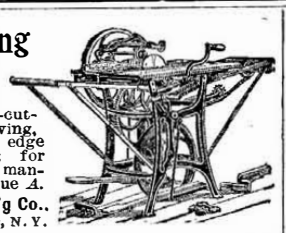
Wood-working Machinery



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ELECTRO MOTOR. SIMPLE, HOW TO make.—By G. M. Hopkins. Description of a small electric motor devised and constructed with a view to assisting amateurs to make a motor which might be driven with advantage by a current derived from a battery, and which would have sufficient power to operate a foot lathe or any machine requiring not over one man power. With 11 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 641. Price 10 cents. To be had at this office and from all newsdealers.

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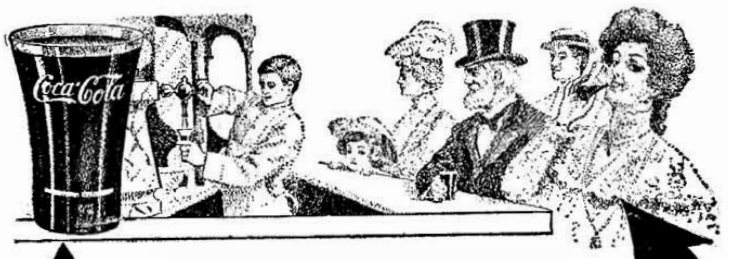

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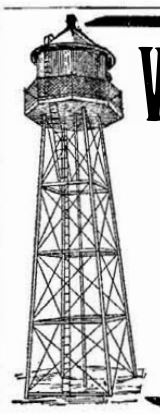

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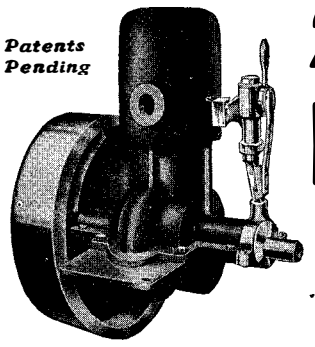

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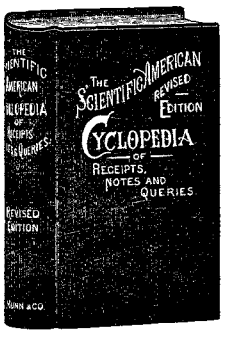

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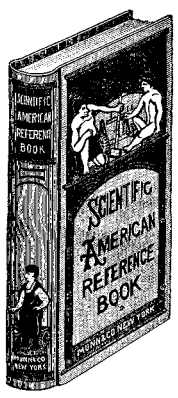

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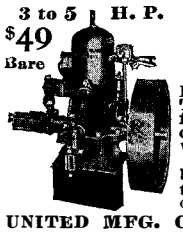

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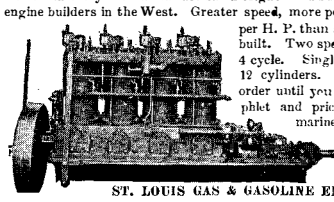

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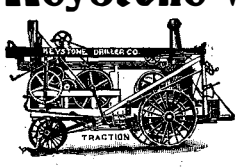

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Paper and carbon tissue, etc., photographic, T. Manly	62,909
Paper, printing and writing, Perfect Safety Paper Co.	62,802
Paper, sheathing, Barrett Manufacturing Co.	62,774
Paper, wall, Alfred Peats Co.	62,789
Papers, photographic, Cross Photo Paper Co.	62,923
Periodicals, Jewelers Circular Publishing Co.	62,905
Pharmaceutical preparation, certain, Ozojell Co.	62,890
Pickles and vinegar, G. B. Gehlert	62,805
Plasters, calcined and casting, S. H. French & Co.	62,834, 62,835
Preparation for diseases of the nose and throat, John C. Lindsey Co.	62,887
Razor strops, Kampfe Bros.	62,811
Remedies for skin diseases, A. Morgan	62,910
Remedies for stomach, kidneys, and liver, A. Fortier	62,924
Remedy for diseases of the liver, Moffitt-West Drug Co.	62,929
Remedy for headache and neuralgia, R. H. Hunstock	62,886
Remedy, liver, A. P. Sawyer	62,932
Rings, finger, Heintz Bros.	62,780
Sauces and dressings, meat and salad, Citizens' Wholesale Supply Co.	62,921
Scrapers, plows, and graders, Smith & Sons Mfg. Co.	62,818
Sheetings and drillings, cotton, Greenwood Cotton Mill	62,878
Sheetings, shirtings, drills, etc., China & Japan Trading Co.	62,775 to 62,777
Shoes, leather, N. H. Marvin	62,928
Silk linings, Wendt Brothers	62,787
Soaps in powdered and cake forms, Great Atlantic & Pacific Tea Co.	62,778
Spectacle and eyeglass lenses, Failing Optical Co.	62,939
Spices and flavoring extracts, Hills Bros.	62,884
Starch, laundry, National Starch Co.	62,930
Starch, laundry, Sherer-Gillett Co.	62,946
Starch polish, B. L. Lent	62,897
Steelware, enameled, Geo. Borgfeldt & Co.	62,902
Stimulant for external and internal use, H. T. Lord Co.	62,815
Stogies, A. Pollack	62,779
Stogies, J. B. Bain	62,826
Stogies, A. Pollack	62,837, 62,880 to 62,883
Stoves and furnaces and parts thereof, Charter Oak Stove and Range Co.	62,808
Straw pipes or tubes, X. G. E. de Faucompre	62,857
Suits, children's play, J. B. Pearson Co.,	62,782, 62,841
Tea, Hills Bros.	62,885
Typewriter ribbons and carbon papers, H. M. Storms Co.	62,879
Wagon jack and grain elevators, combined, J. A. Engel & Co.	62,904
Washboards, American Washboard Co.,	62,790 to 62,795
Washing crystal, compounds for softening water, etc., Sherer-Gillett Co.	62,916
Water, carbonated, L. D. Childs	62,830
Water motors, water motor pumps, and water lifts, Organ Power Corporation	62,911
Whisky, Bay View Wine Co.	62,827
Whisky, Eminence Distillery Co.	62,855
Whisky, Labrot & Graham	62,906
Whisky, gin, and brandy, Figge-Doyle Co.	62,832
Woolen piece goods, Western Reserve Woolen Co.	62,788

LABELS.

"Caswell's High Grade Coffee, Black and Orange Package," for coffee, George W. Caswell Co.	13,565
"Caswell's High Grade Coffee, Blue and Red Package," for coffee, George W. Caswell Co.	13,563
"Caswell's High Grade Coffee, Green and Red Package," for coffee, George W. Caswell Co.	13,564
"Caswell's High Grade Coffee, Yellow and Blue Package," for coffee, George W. Caswell Co.	13,566
"Duke of Navarre," for cigars, A. M. Zellingold	13,559
"Lady Slipper," for chocolates, W. A. Whitelaw & Co.	13,561
"Lakewood Spring Water," for spring water, E. O. Foot	13,567
"Lydia E. Pinkham's Blood Purifier," for medical compounds for the purification of the blood, Lydia E. Pinkham Medicine Co.	13,569, 13,570
"Madam De Savon's Ponce De Leon New Thought Toilet Articles," for face powder, cream, cream jelly, foot comfort, and hair tonic, C. D. Schureman	13,572
"Newleans," for syrup, Columbia Coffee Mills	13,562
"Panama Ant Poison," for an insecticide, C. A. Walsdorf	13,573
"Rivets," for rivets, E. B. Stimpson	13,575
"Silesia Mineral Water," for a mineral water, Silesia Mineral Spring Co.	13,568
"St. Philip Hair Tonic and Dandruff Cure," for hair preparation, P. Aceto	13,571
"Stephenson The Original Uneed A Bar Belt Dressing," for a belt dressing, Gem Manufacturing Co.	13,574
"White Ribbon," for cigars, C. B. Henschel Mfg. Co.	13,560

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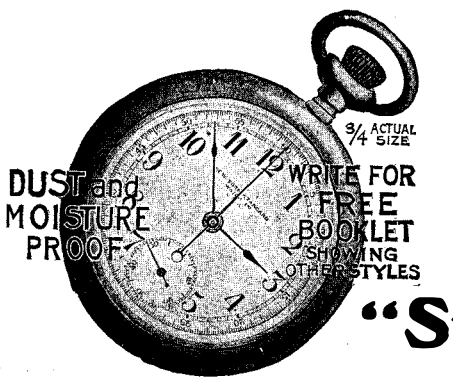

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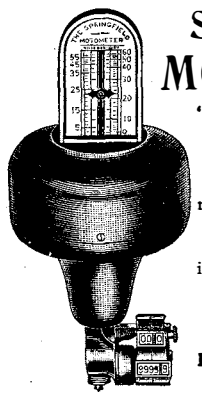
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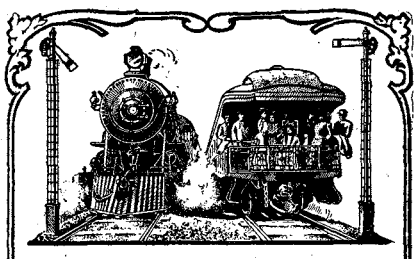
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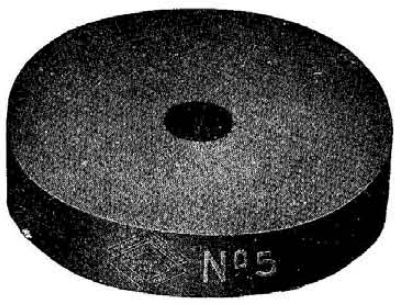

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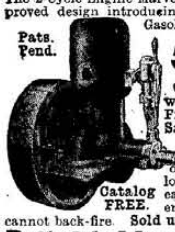

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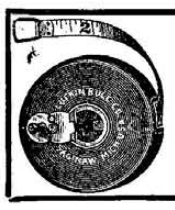

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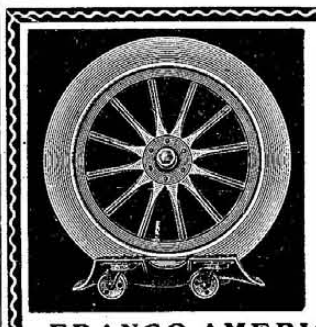

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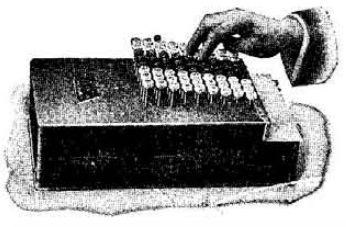

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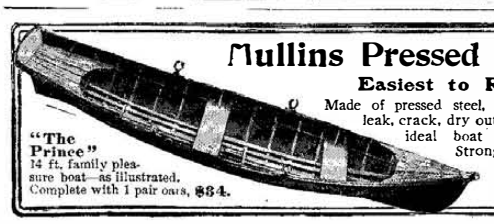

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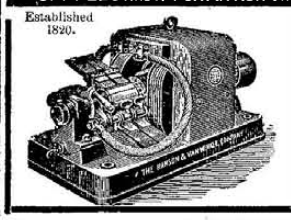

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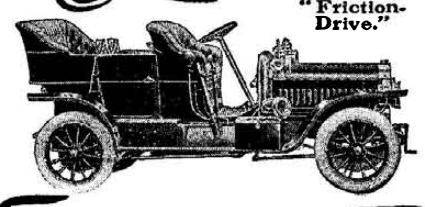

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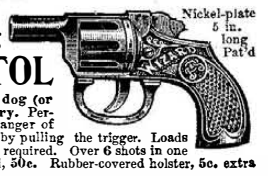

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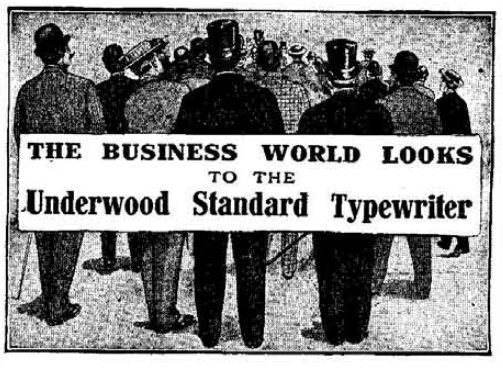

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